MARCH 14, 1936

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ELECTRICAL WORLD

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AMERICAN HOUSEWIVES WANT APPLIANCES

Proof of this statement is found in the data of Electrical World's fifth semi-annual survey of utility and dealer appliance sales for the full year 1935, in this issue

What Type Supervisory? + + + High-Capacity Switchgear + + + Appliance Merchandising in 1935 + + + Who Has Refrigerators—Who Can Buy? + + + Reclaiming Old Insulating Oil. Linear Depreciation Unsuited for Hydro + + + Chicago Starts Network in the Loop. Industry Opinion on Highway Lighting + + + Carter Field on Events in Washington

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Logically, modern maintenance chooses WESTON Juniors for this important task . . . for these instruments are small, compact, ruggedly constructed to withstand hard usage, and are inexpensively priced; yet they are built to the high standards of dependability for which WESTON instruments are famous. The Junior line consists of DC instruments, AC instruments and single phase Wattmeters. Full information is available . . . Weston Electrical Instrument Corp., 578 Frelinghuysen Ave., Newark, N. J.

WESTON *Instruments*

ELECTRICAL WORLD

FOUNDED IN 1874 ✦ ✦ READ BY ELECTRICAL MEN FOR SIXTY YEARS

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Reader's Guide to This Issue

Was 1935 a bad merchandising year? Not when $67,000,000 worth of appliances were sold by 103 utilities producing an aggregate gain in gross revenue of more than $11,000,000. These figures, and others equally startling, presented in ELECTRICAL WORLD's semi-annual merchandising survey, tell an amazing story of progress by presenting a factual report covering the load-building activities of the industry for 1935 on a national scale. Tables are presented that give a detailed comparison of appliance sales by both utilities and dealers for the full year 1935 against that for 1934. Others show trends in appliance rentals, and consumption and load growth data for companies that do not sell appliances. No interpretation is given or needed, the facts tell the story.

●

Of Executive Interest

Utility appliance sales data. Linear depreciation for hydro—not suitable. Executives discuss highway lighting. Technique speeds rate analysis.

●

For Power Company Engineers

Network system for Chicago's loop. Selecting Supervisory—how, why. High-capacity switchgear design. Old insulating oil reclaimed chemically.

●

On Power Company Sales

National utility appliance sales—1935. Who can buy refrigerators. The utilities and highway lighting. Concluding bakery data sheets—to be followed by those on laundries.

●

For Electrical Engineers

Utility opinion on highway lighting. Selection of supervisory—how, why. Design switchgear for easy maintenance.

●

For Electrical Manufacturers

Appliance sales for 1935—utilities, dealers. Refrigerators—a market survey. Improved highway lighting to cut accidents—utility opinion.

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Coming Features

Paint a Partner in Better Seeing

Properly finished walls and ceiling surfaces go hand in hand with modern lighting design to provide abundant diffuse illumination for industrial operations. A. H. Kennedy tells what leading industries are doing with paint to relieve eye strain and overcome light handicaps.

●

T.V.A. Chooses Wood in Lightning Areas

T.V.A. Engineers Llewellyn Evans and H. C. Daniels tell of the story of a searching analysis that led to the selection of a unique wooden construction for their 154-kv. transmission line from Wilson Dam to Norris Dam severely exposed to lightning.

●

Small Refrigerators and the Minimum Bill

Five utilities develop minimum bill customers into profitable customers by interesting them in refrigerators. Methods and results of their campaigns make a vitally interesting story for load builders.

●

Low Cost Grounding of Lighting Standards

Here's how Kansas City Power & Light Company grounded 1,424 boulevard fixtures at a unit cost of $2.46. Some of the standard fixtures were grounded in one minute flat, some longer; the whole story, with costs, is told by T. G. Hieronymus.

●

Extension Wiring System

Additional outlets in already wired homes without reverting to "haywire" are made possible by a newly developed system that looks good and meets underwriters' requirements. A new solution to an old problem.

●

Capacitors Prove Out in Service

Messrs. Van Horn and Hill tell of ten years experience with a 5,400-kva. capacitor installation at the United Illumination Company, Bridgeport. They say they experienced less than 3 per cent of failures.

ELECTRICAL WORLD—Published every Saturday. Price 25 cents a copy. Subscription rates: United States, Canada, Mexico, Central and South American countries, $4 a year; all other countries, $6 or 24 shillings a year. Entered as second-class matter, January 20, 1907, at Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U.S.A.

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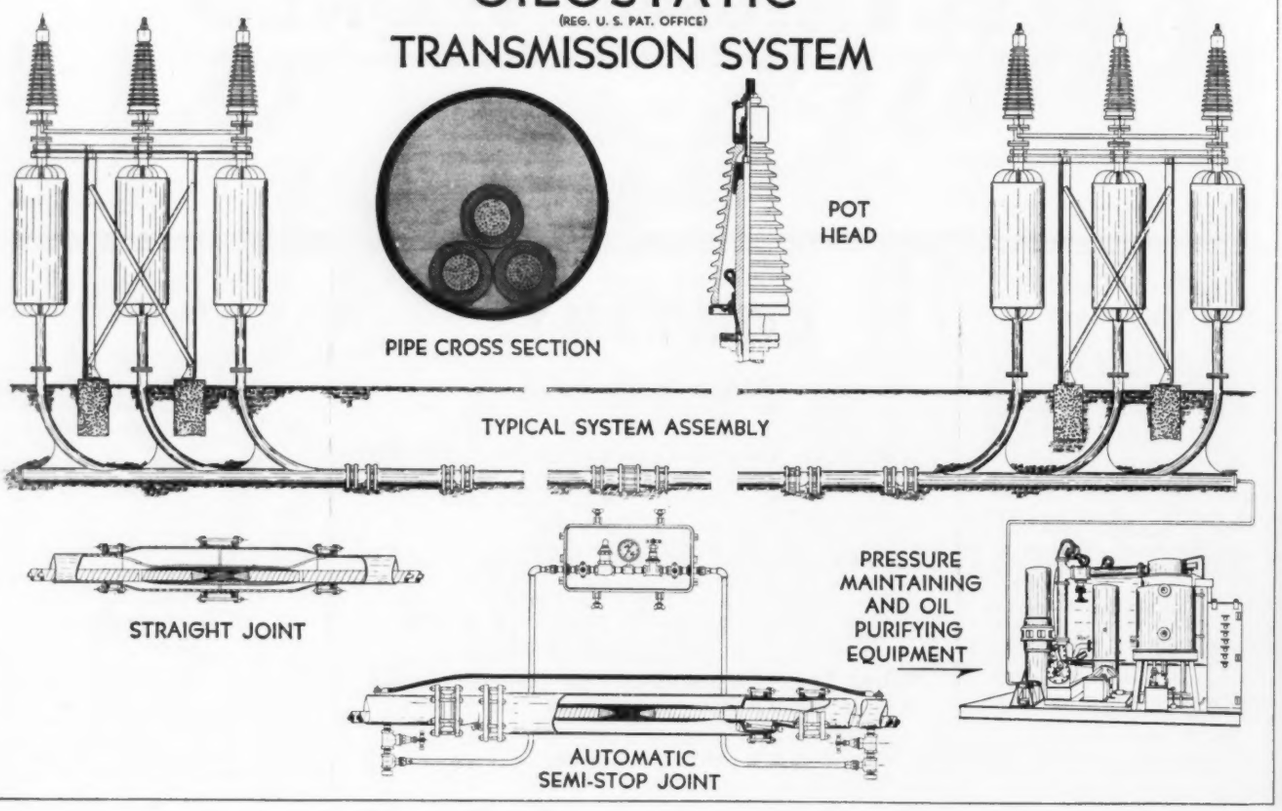
OILOSTATIC

(REG. U. S. PAT. OFFICE)

TRANSMISSION SYSTEM



IN the Oilostatic Transmission System developed and manufactured by the Okonite-Callender Cable Co., Inc., the insulated conductors are in buried metal pipe filled with oil, maintained under a constant pressure. Above typical Oilostatic layout shows simplicity of pumping, valve, joint and pothead equipment.

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OF PYREX INSULATORS

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INSULATORS

The "MELODY MASTER" RADIO PROGRAM

makes a definite contribution to

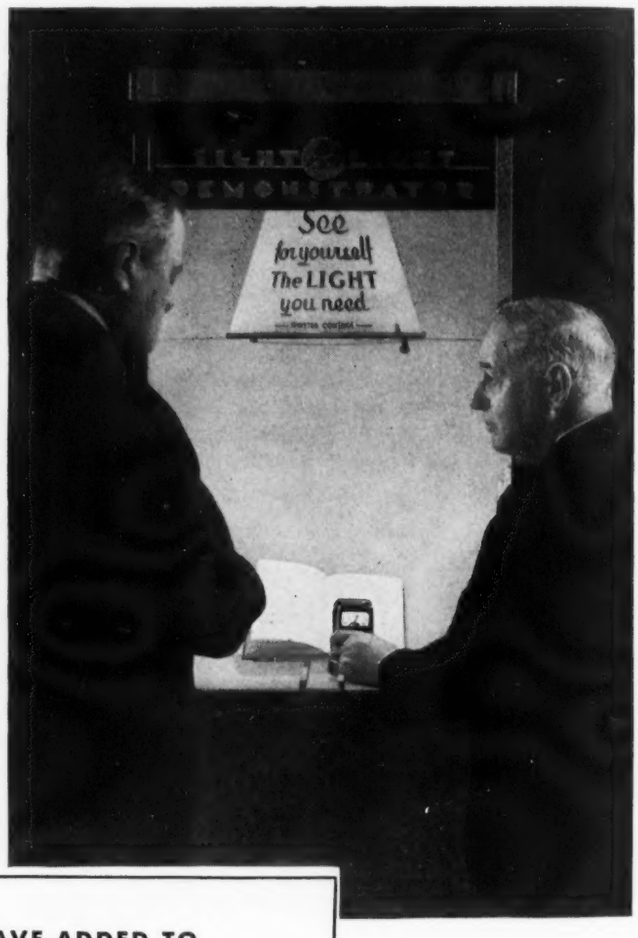
BETTER LIGHT-BETTER SIGHT

The Melody Master radio program, sponsored nationally by General Electric and locally by nearly forty public utilities, is making a definite contribution toward promoting Better Light-Better Sight.

The program has been on the air a comparatively short time. It is broadcast over 13 stations of the N. B. C. Basic Red Network each Sunday night at 11 P.M. (E.S.T.) Yet conservative estimates indicate that it has built a weekly audience in more than half a million homes . . . and that this audience is constantly increasing.

Skillfully woven into the program is the dramatized Better Light-Better Sight message. Each week the featured guest makes a test with a Sight Light Demonstrator to let his eyes select the light they would choose for close seeing. Today in more than half a million homes, listeners know more about the advantages of better lighting than they did before the program started . . . last October 20th.

The addition of a well-loved guest artist each week, the predominance of excellent instrumental and vocal music, and the dramatized Better Light-Better Sight message have combined to place the program on a high level of audience acceptance. For an illustrated folder containing more detailed information, write to Dept. 166, Nela Park.



● *Albert Payson Terhune, one of the many featured guests who make the Sight Light test each week. Jack Norworth, veteran stage favorite and "John Clemens" in the program, is holding the Light Meter. The entire Sight-Light Demonstration is dramatized each week as a part of The Melody Master program.*

SOME OF THE GUEST ARTISTS WHO HAVE ADDED TO "MELODY MASTER" ENTERTAINMENT RECENTLY

1. **CARRIE JACOBS-BOND,** author of "The End of a Perfect Day" and many other well-loved songs and poems, was a featured guest December 15th.

2. **FRITZI SCHEFF,** star of many a Victor Herbert operetta, was featured along with Victor Herbert music on the December 29th program.

3. **ANGELO PATRI,** beloved educator and national authority on child psychology, appeared on the January 12th Melody Master program.

4. **THE CHARIOTEERS,** popular and versatile colored quartette, were featured with Oley Speaks on the January 19th program.

5. **BRUCE BAIRNSFATHER,** internationally famous for his "Ole Bill" and "The Better 'Ole" cartoons, was guest artist on Jan. 26th.

6. **FRANK** (Bring 'em Back Alive) **BUCK,** told some of his thrilling jungle experiences as Clem's guest on February 2nd.

7. **WILLARD ROBISON,** composer, singer, and conductor, was the featured guest on the February 16th program.

8. **ARTHUR PRYOR,** composer and America's foremost band conductor, appeared with Beatrice Herford on the February 23rd program.

GENERAL ELECTRIC

LETTERS TO THE EDITOR

Not in Receivership—Bonds Above Par

To the Editor of ELECTRICAL WORLD:

Our attention having been called to tabulations appearing on page 71 of the January 4, 1936, issue of the ELECTRICAL WORLD purporting to show that Northwestern Electric Company defaulted on its first mortgage twenty-year sinking fund gold bonds which were due May 1, 1935, and that it was in receivership during 1935, we are constrained to advise you that the information so published (without even approximately adequate explanatory notes) is unfair to Northwestern Electric Company.

Conditions wholly beyond the control of the officers and directors of Northwestern Electric Company prevented the refunding of this issue of bonds at maturity, but the company had presented to its bondholders in January, 1935, an extension proposal and agreement contemplating the extension of the maturity of such bonds for ten years, and on the actual maturity date (May 1, 1935) the holders of more than 74 per cent in principal amount of such bonds had approved and accepted this extension plan. By order of the District Court of the United States for the District of Oregon dated July 22, 1935, the company's extension plan was confirmed and approved as a plan of reorganization under the provisions of the familiar Section 77B and more than 97 per cent in principal amount of the bonds has now been deposited under the terms of such plan. Furthermore, the court did not find it either necessary or desirable to appoint a trustee or trustees of the company's properties, but continued its then and present management in complete control of all of its properties and operations.

You will be interested in noting that the Northwestern Electric Company bonds so extended are selling at better than par on the New York Curb Exchange.

PAUL B. MCKEE,
President,
Northwestern Electric Co.,
Portland, Ore.

Due to necessary brevity in the annual Statistical Issue of ELECTRICAL WORLD the facts regarding Northwestern Electric Company bonds were not fully stated. We are glad to publish Mr. McKee's letter.—EDITORS.

•

Boulder Generators Polyphase

To the Editor of ELECTRICAL WORLD:

Perhaps a humble person like myself can whisper a comment from this secluded spot 150 miles west of Calcutta.

It took some serious efforts to convince some of my associates that the Boulder Dam generators were not single phase, as listed in the August 17 issue of ELECTRICAL WORLD. Doubtless this apparent discrepancy has been drawn to the attention of your office from 999 other sources. You may judge, however, that your publication is receiving more than a glance at this spot.

C. O. VON DANNENBERG,
4 Office Road,
Jamshedpur, India.

•

Neutral Resistor Should Limit Fault Current

To the Editor of ELECTRICAL WORLD:

Reading the published information on the trouble of January 15 at the Hell Gate station creates the impression that too much weight cannot be given complete automatic protection in a generating station. According to the report, all sources of energy except the generators were cleared from the bus automatically. The inevitable delay incident to an operator's observance and analysis of a fault condition and the physical motions necessary to clear it affords ample time for a simple failure to become a cataclysm. That power from the generators was the continuing cause of damage is indicated by the burning off of a generator neutral.

The lesson to generating station operators and designers seems to be that the best way to limit the destructiveness of a fault is to clear it as rapidly as possible. This calls for automatic protection, which in the case of a bus failure will infallibly clear all sources of energy from the section involved as quickly as possible.

That such protection operating successfully would have prevented the second bus at Hell Gate from becoming involved is a question to which an answer cannot be dogmatically given. Observations of a somewhat comparable case a few years ago suggests that it might. One may wonder also whether the damage would have been lessened and its extent restricted by a neutral resistor of a size which, without endangering proper relay functioning, would have limited the fault current.

Such tests of modern generating station design have been fortunately rare. Perhaps the designer may assume the credit for this, but the true merit of the design is never known until it is submitted to unusual stress and the results analyzed, assuming there is enough evidence left to analyze. The lessons thus learned are helpful even if painful.

WELLEN H. COLBURN,
Wollaston, Mass.

As the fuller facts become known engineers are bound to form opinions about future protection policies founded on the Hell Gate lesson. Mr. Colburn seems to differ with the tone of our first news report, which perhaps gave the impression that too much reliance should not be placed on automatic protective equipment. If that impression was given it was because time had not intervened to afford engineers a better basis (see H. C. Forbes in February 1 issue) for judging the cause. Possibly some will argue for more manual means of tripping in extreme emergency in order to forestall follow-up damage whenever the automatic equipment itself has been involved in the initial fault and cannot therefore render the functions which it alone can do at the speed that is called for by modern power intensities and concentrations.—EDITORS.

•

Coupling Capacitor Discussion

To the Editor of ELECTRICAL WORLD:

On Page 54 of your September 14 issue there appeared a brief report of the Seattle convention of the A.I.E.E. under the caption "Spirited Discussions Feature A.I.E.E. Meeting." In the first paragraph of this report mention is made of my paper describing the coupling capacitors furnished for the Boulder Dam-Los Angeles line. It is recorded that L. R. Ludwig, Westinghouse Electric & Manufacturing Company, commented adversely upon the design described in my paper, pointing out what he thought were excessive working stresses representing a hazard to the line, and implying that his company's product required three times as much working material for the same service.

It is recognized in the engineering profession that a smaller quantity of more carefully selected material may have a dependability, when properly engineered, equal to that of a larger quantity of material of less uniform quality or generally lower strength or utilized to poorer advantage in the design. Furthermore, experience has shown that, as a rule, the former practice results in greater economy than the latter.

It may be pointed out that, except for even lower stresses, the Boulder Dam coupling capacitors are comparable in all essentials of design to the capacitors regularly used for the correction of power factor in transmission circuits. The notably excellent record of these modern oil-paper power-factor correction capacitors attests the dependability of such devices. The lower stresses used in the coupling capacitors give a still greater factor of safety against all voltages encountered in service. Similar capacitors are employed also in the construction of General Electric impulse generators, which are used to determine the overvoltage characteristics of all transmission apparatus, as well as lightning arresters. Such capacitors receive far more severe and frequent abuse from overvoltage surges than apparatus in actual operation, whether protected with lightning arresters or not. Since the design of the coupling capacitors is more conservative than modern power-factor correction capacitors and the impulse generator capacitors, both of which have fully demonstrated their dependability, the assumption that the coupling capacitors represent a hazard to the line is obviously without foundation.

E. D. EBY,
Engineer,
High-Voltage Bushing Dept.,
General Electric Co.

THE CAREFUL INVESTOR JUDGES A SECURITY

BY THE HISTORY OF ITS PERFORMANCE

KERITE

IN THREE-QUARTERS OF A CENTURY OF

CONTINUOUS PRODUCTION HAS ESTABLISHED

A RECORD OF PERFORMANCE

THAT IS UNEQUALLED IN THE HISTORY OF

INSULATED WIRES AND CABLES

THE KERITE INSULATED WIRE & CABLE COMPANY INC

NEW YORK CHICAGO SAN FRANCISCO

ELECTRICAL WORLD

MANAGEMENT • ENGINEERING • OPERATION • UTILIZATION

PUBLISHED EVERY SATURDAY

MARCH 14, 1936

Lawyers Battle, but Construction Starts—

More taxes are in the offing. Congress fears to face the issue frankly. So does the Administration. The latest dodge is to soak the surplus funds of industry. This is a steppingstone to state socialism. Only surplus savings saved American business enterprises from failure during this depression and maintained employment. If these funds had not been available the state would have been compelled to take over business. Is this new tax proposal a planned step to this end or just an expedient signal by the quarterback?

The threat of more taxes is curtailing Congressional spending. Norris accepts a big cut in his rural electrification plan. Even so, we doubt if this sum can be spent. Farmers will not pay five to eight dollars a month as fixed charges for line, wiring and equipment and, in addition, three or four dollars for current. This plan is a theory only and may be scrapped. If it is forced into operation we predict that many co-operative rural lines will once again be taken over for one dollar and good will by private utilities in future years.

Lawyers are still having a field day. Each week adds to the record of utility court cases and appeals from current decisions to higher courts. Also the Black committee, the S.E.C., the Federal Trade Commission and the Federal Power Commission are making plenty of legal work. There will be an increase of this legal warfare in coming months. It is necessary, although expensive and defensive.

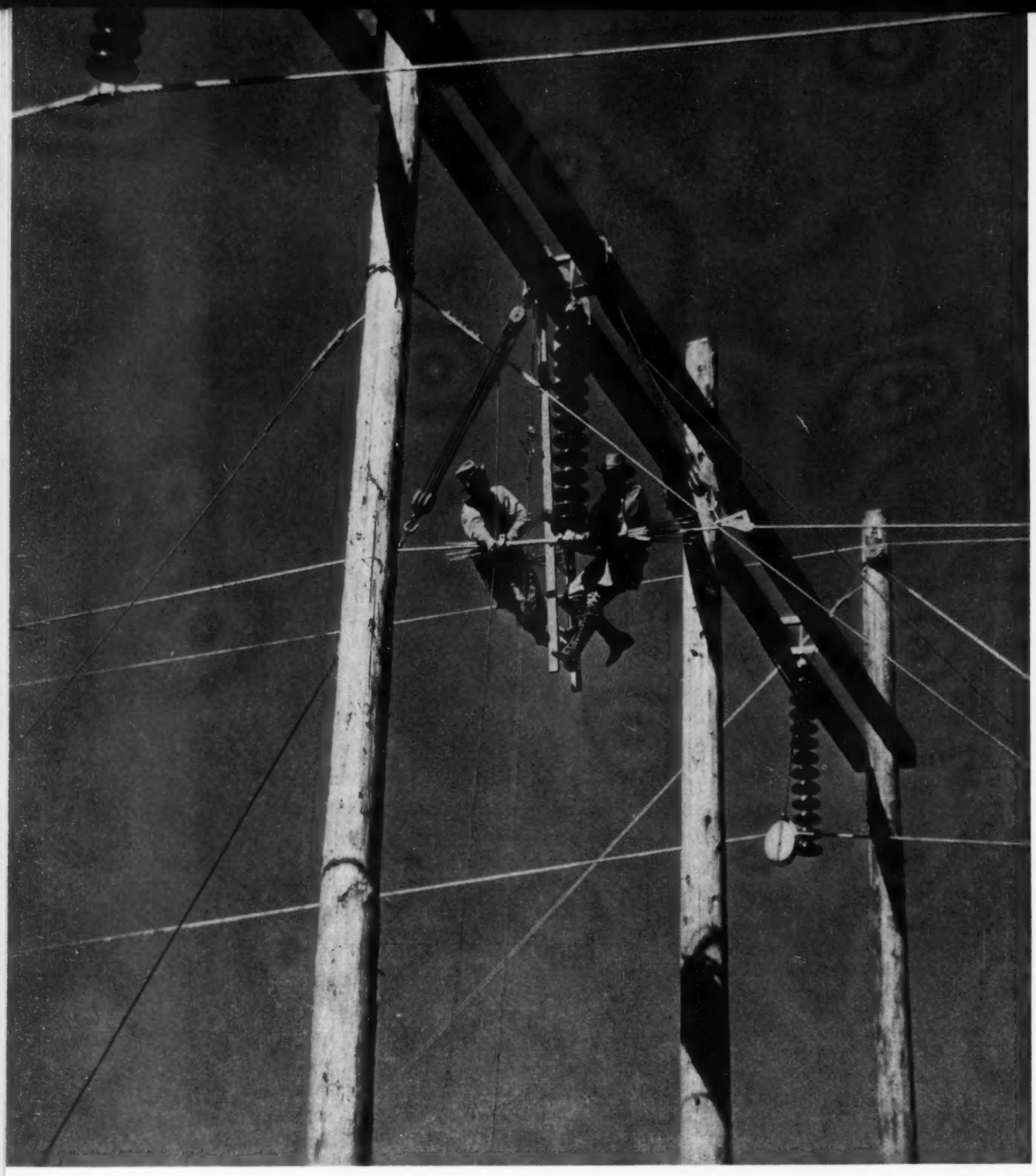
This brings up the other and more favorable aspect of industry activity. Load continues to increase and sales of apparatus and appliances mount steadily. An organized and worthwhile new development is the formation of the Industry Promotion Committee. This has long been needed. It will support and make more effective the sales programs of individual enterprises.

Add to this the break-up of a long, cold winter that will permit construction work to be undertaken by utilities, industrials and building contractors. There is much to be done and the start of this work will give a further spur to business recovery. Most of this work will affect the heavy industries favorably and will add greatly to employment. The electrical industry expects to be a leader in new construction this year. Fortunately the credit position for business enterprises is splendid and they can get the funds necessary for rehabilitation and expansion.

Just to add a human note to current happenings, the A.I.E.E. is sponsoring a nation-wide celebration of the fiftieth anniversary of the establishment of the alternating-current system. Meetings to honor the pioneers should stimulate engineers of today to follow in their footsteps.

Geo. W. Morrow

Editor



CLIPPING IN A T.V.A. TRANSMISSION LINE

Linemen install armor rods on the T.V.A. wood-pole transmission line connecting Wilson and Pickwick Dams on the Tennessee. This line was recently completed.

Who Has Refrigerators? Who Can Buy?— *A Market Study by Income Groups*

Two Types of Market Are Shown—One Has Been Developed—Another and Potentially a Much Larger One Is Seen in Cheaper Units for the Lower Income Groups

AS RECENTLY as ten years ago a very simple answer could have been given to several questions regarding electric refrigerators. "Who has them?" "Scarcely any one." "Who can buy?" "The well-to-do." The number in use in 1926 was estimated at 145,000, or about one in a hundred electrically served homes. In the interim the number of such homes has increased by a half, but the number of refrigerators has multiplied more than 30-fold. Annual production has for several years exceeded a million units. A portion of the market has been pretty fully sold, but large numbers of electric consumers are still without them. For the first time it is now possible to approach this question of the market on a statistical basis directed to definite income groups.

Under the title "Consumer Use of Selected Goods and Services by Income Classes" the Department of Commerce has issued a series of market research reports embodying the results of surveys in seven cities—Austin, Tex.; Fargo, N. D.; Portland, Me.; Columbia, S. C.; Trenton, N. J.; San Diego, Calif.; Salt Lake City, Utah. Others are to follow, but these seven suffice for the making of estimates, by income groups, of the national market that are sufficiently accurate for the present purpose. The total checks well with accepted figures.

From Table I it is evident that the cities selected are widely scattered. Various parts of the country are represented. The groups are said to have been carefully selected so as to give a representative cross-section. Various data of value in a market analysis were collected. The present article is confined to mechanical refrigeration, except that for comparison the number of families reporting the use of electric light is included.

Other tables show the number and percentage of families, by income groups, and the number and percentage of these families using refrigerators, also the per cent saturation in each group. Finally, there are totals and averages for the seven cities as a whole. All of these figures apply to the year 1933.

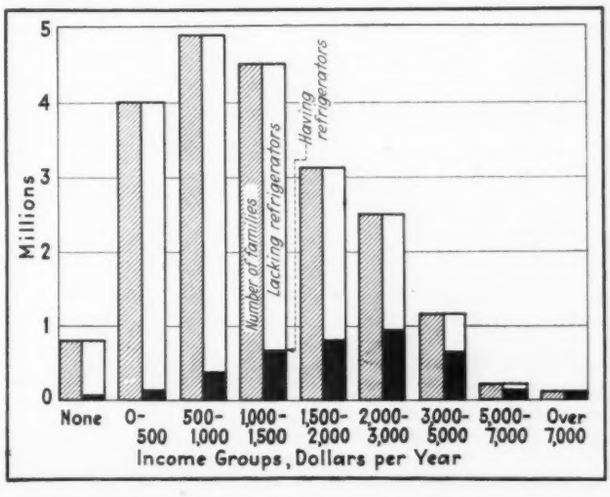
Most incomes under $2,000

In all, 25,667 families were studied. Only 7 per cent had incomes of $3,000 or more. Two-thirds had less than $1,500. More than a fifth had less than $500. These are, of course, depression figures. Normally, incomes would be higher. No doubt many of these people were drawing on savings, for even the lowest income classes had an appreciable number of automobiles and refrigerators and they were living in homes equipped with such facilities as bathtubs or showers.

While the average saturation of refrigerators was 18.6 per cent in all the families studied, the upper 7 per cent as to income had 23 per cent of the refrigerators and the average saturation for these groups was 60 per cent. Moreover, there is a progressive increase in saturation as we pass from the lower to the higher income brackets, except for the "no income" group. The percentages differ in the several cities, but the general rule prevails in all.

Two classes of market

There evidently remains a considerable market, aside from replacements, in the higher income classes. But there is a far larger potential market in the great mass of people having less than $3,000 a year. Can they buy? The answer is that many have already done so. Here again progress depends on healthy industrial and commercial recovery. As earnings



How 4,000,000 refrigerators are distributed among 21,286,000 nonfarm families
Estimated allocation in 1933

Table I—Number of Families Studied and Number of These Having Refrigerators

City	Total Families (Census of 1930)	Families in This Study	Size of Sample (Per Cent of Total)	Number Reporting Refrigerators	Per Cent Reporting Refrigerators	Number Reporting Electric Light	Per Cent Reporting Electric Light
Austin, Tex.	12,767	1,697	13.3	273	16.1	1,404	82.7
Fargo, N. Dak.	6,612	1,403	21.2	395	28.2	1,399	99.7
Portland, Me.	17,478	3,097	17.7	521	16.8	3,055	98.6
Columbia, S. C.	11,184	1,697	15.2	310	18.3	1,134	66.8
Salt Lake City.	34,410	6,528	19.2	1,732	26.5	6,496	99.5
Trenton, N. J.	27,130	3,707	13.7	344	9.3	3,533	95.3
San Diego, Cal.	45,227	7,538	16.7	1,204	16.0	7,485	99.3
Totals, averages	154,808	25,667	16.6	4,779	18.6	24,506	95.5

Table II—Families Studied in Selected Cities

By Income Groups (Dollars per Year)

City	None	0–499	500–999	1,000–1,499	1,500–1,999	2,000–2,999	3,000–4,999	5,000–6,999	7,000–over	All
Austin	45	379	394	300	205	190	133	36	15	1,697
Fargo	51	169	263	302	240	236	113	22	7	1,403
Portland	69	374	631	733	532	459	215	48	36	3,097
Columbia	44	646	349	178	164	162	119	22	13	1,697
Salt Sake City	237	1,451	1,503	1,305	907	694	328	58	45	6,528
Trenton	297	729	1,021	765	398	334	121	32	10	3,707
San Diego	257	1,059	1,716	1,837	1,316	914	346	65	28	7,538
Total	1,000	4,807	5,877	5,420	3,762	2'989	1,375	283	154	25,667
Per Cent	*3.9*	*18.7*	*22.9*	*21.1*	*14.7*	*11.6*	*5.4*	*1.1*	*0.6*	*100.0*

Refrigerators, by Income Groups

Austin	7	6	14	37	46	63	69	23	8	273
Fargo	8	8	30	60	77	111	79	16	6	395
Portland	5	24	48	86	88	117	96	29	28	521
Columbia	3	9	16	28	64	89	74	14	13	310
Salt Lake City	26	79	178	337	367	415	246	46	38	1,732
Trenton	9	11	46	63	59	76	50	23	7	344
San Diego	25	43	139	205	275	290	176	34	17	1,204
Total	83	180	471	816	976	1,161	790	185	117	4,799
Saturation per cent	*8.3*	*3.7*	*8.0*	*15.1*	*25.9*	*38.8*	*57.*	*65.3*	*76.2*	*18.6*

Table III—Distribution of Population and Refrigerators by Income Groups

Per Cent of Population in Each Income Group

City	No Income	$1 to $499	$500–$999	$1,000–$1,499	$1,500–$1,999	$2,000–$2,999	$3,000–$4,999	$5000–$6,999	$7,000–Over	All Classes
Austin, Tex.	2.7	22.3	23.2	17.7	12.1	11.2	7.8	2.1	0.9	100.0
Fargo, N. Dak.	3.6	12.1	18.7	21.5	17.1	16.8	8.1	1.6	0.5	100.0
Portland, Me.	2.2	12.1	20.4	23.7	17.2	14.8	6.9	1.5	1.2	100.0
Columbia, S. C.	2.6	38.1	20.5	10.5	9.7	9.5	7.0	1.3	0.8	100.0
Salt Lake City.	3.6	22.2	23.0	20.0	13.9	10.7	5.0	0.9	0.7	100.0
Trenton, N. J.	8.0	19.7	27.5	20.6	10.7	9.0	3.3	0.9	0.3	100.0
San Diego, Cal.	3.4	14.0	22.8	24.3	17.5	12.1	4.6	0.9	0.4	100.0

Per Cent of Refrigerators in Each Income Group

Austin, Tex.	2.6	2.2	5.1	13.6	16.8	23.1	25.3	8.4	2.9	100.0
Fargo, N. Dak.	2.0	2.0	7.6	15.2	19.5	28.1	20.0	4.1	1.5	100.0
Portland, Me.	1.0	4.6	9.2	16.5	16.9	22.4	18.4	5.6	5.4	100.0
Columbia, S. C.	1.0	2.9	5.2	9.0	20.6	28.7	23.9	4.5	4.2	100.0
Salt Lake City.	1.5	4.6	10.3	19.4	21.2	23.9	14.2	2.7	2.2	100.0
Trenton, N. J.	2.6	3.2	13.4	18.3	17.2	22.1	14.5	6.7	2.0	100.0
San Diego, Cal.	2.1	3.6	11.6	17.0	22.8	24.1	14.6	2.8	1.4	100.0

Per Cent Saturation in Each Income Group

Austin, Tex.	15.6	1.6	3.6	12.3	22.4	33.2	51.9	63.9	53.3	16.1
Fargo, N. Dak.	15.7	4.7	11.4	19.9	32.1	47.0	69.9	72.7	85.7	28.2
Portland, Me.	7.2	6.4	7.6	11.7	16.5	25.5	44.7	60.4	77.8	16.8
Columbia, S. C.	18.2	1.4	4.6	15.7	39.0	54.9	62.2	63.6	100.0	18.3
Salt Lake City.	11.0	5.4	11.8	25.8	40.5	59.8	75.0	79.3	84.4	26.5
Trenton, N. J.	3.0	1.5	4.5	8.2	14.8	22.8	41.3	71.9	70.0	9.3
San Diego, Cal.	9.7	4.1	8.1	11.2	20.9	31.7	50.9	52.3	60.7	16.0

rise and as their continuance is assured, purchasing will increase. This increase will be greatly stimulated as manufacturers succeed in developing appliances suited to people of limited income. That is the big unsaturated market that now challenges the industry.

Nation-wide possibilities in figures

According to the census for 1930 there were in the United States 21,286,000 non-farm families, including those in cities and towns and those in rural villages. If we assume that these families are distributed by income groups in the same proportion as those in the seven cities the allocation will be as in Table IV. Applying in each group the average percentage saturation prevailing in the seven cities, there results the number of refrigerators given in that table, the total being approximately 4,000,000. This checks satisfactorily with the estimate of 4,660,000 by *Refrigeration News* for the end of 1933 if allowance is made for the families in the higher income brackets, not proportionately represented in cities of moderate size, and for those in that portion of our 30,000,000 families that is not included in the present computation.

This means that the possibilities in the upper brackets are somewhat larger than the table indicates, but the fact remains that the time has come for concentrating on the lower brackets, comprising some 10,000,000 families, many of them dwelling in the thousands of small cities and towns where a modest income is adequate for a decent standard of living.

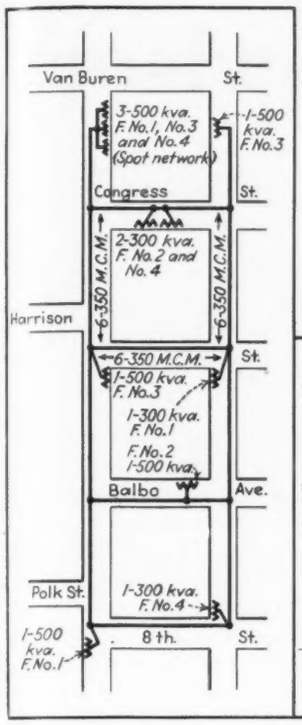
Table IV — Income Groups and Refrigerator Installations

Non-Farm Families

Estimate based on averages for seven selected cities and 1930 census total of 21,286,000 non-farm families

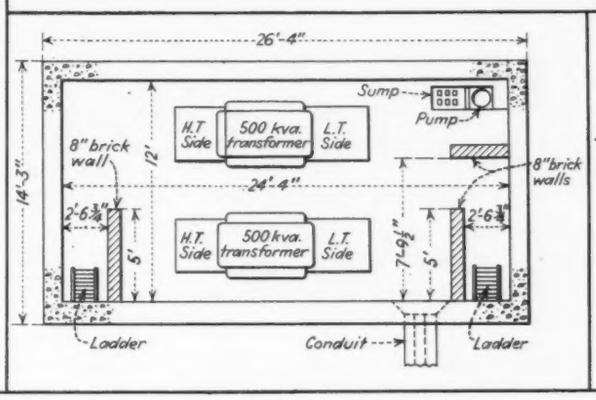
Income Group (Dollars)	Number of Families	No. with Refrigerators	Number Lacking Refr'rs
0	831,000	69,000	762,000
1–499	3,983,000	148,000	3,835,000
500–999	4,870,000	390,000	4,480,000
1,000–1,499	4,490,000	680,000	3,810,000
1,500–1,999	3,130,000	812,000	2,318,000
2,000–2,999	2,470,000	960,000	1,510,000
3,000–4,999	1,150,000	662,000	488,000
5,000–6,999	234,000	153,000	81,000
7,000 & over	128,000	98,000	30,000
Totals	21,286,000	3,972,000	17,314,000

Chicago Starts Network in Loop

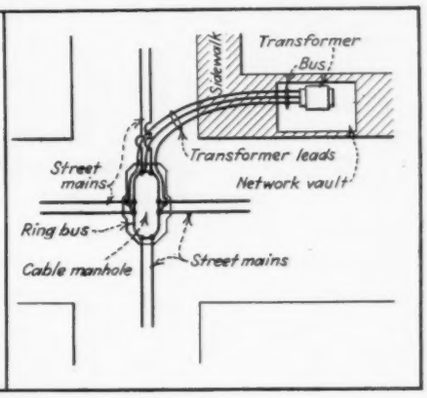


Initial network embraces four city blocks

Network transformer vault houses two 500-kva. units



Transformer leads feed ring bus



Alternating-Current Supply Begins Taking Over Load in Direct-Current Area South of the Loop—Substation Investment Is Avoided

By K. M. SMITH
Planning Engineer,
Commonwealth Edison Company, Chicago

INITIAL installation of an alternating-current network in Chicago is now in progress in an area immediately adjacent to the Loop district. This installation is being made to provide relief by cutover for the d.c. substation whch now supplies the area, in lieu of the construction of a new d.c. substation. It is to be installed in steps to absorb the growth and reduce the load on the present substation and will also form the nucleus of a system which will be extended to supply new load or for the relief of other d.c. substations.

Four blocks are covered by the portion of the system first installed. Each is about 400 ft. square and the territory is almost entirely commercial in character. Load amounts to about 2,000 kw., about half of which is made up of customers having from 100 to 600 kw. maximum demand, the rest being in small shops and theaters and minor manufacturing. Load density in this and adjacent territory is about 40,000 kva. of substation maximum demand per square mile.

Network transformers are three-phase units of 300 and 500 kva. capacity. They are equipped with secondary network protectors and primary disconnects providing for an open, closed and ground position. The transformers have 5½ per cent impedance and a voltage rating of 12,000-213 volts. No external reactances are used except balancing transformers in building vaults. Primary windings have taps for two 2 per cent steps below and one 2 per cent step above 12,000 volts. Generally, each vault will have one 500-kva. unit installed, although space is provided for a future second unit. Two 300-kva. units are planned for several vaults initially or in the immediate future.

Doubled conductor secondary system

Secondary mains in the street consist of two sets of three 350,000-circ.mil single-conductor, lead-covered cables with a No. 4/0 lead-covered neutral conductor. One set of mains is installed on each side of the street except on frontages where no service taps are required. Selection of 350,000-circ.mil cable for this purpose was based partly on the existence of a stock of cable of this size for which no other use was expected and partly on the size of the existing conduit, which is quite old and too small to permit installation of three larger cables in a duct. In some cases, due to this condition, it will be necessary to install the neutral conductor in a separate duct.

Transformers are connected to the system of street mains by multiple circuits of 500,000-circ.mil one-conductor cable. These loads, which will average about 60 ft., are to be brought from a bus in the transformer vault to an adjacent cable manhole where the leads and the several sets of street mains are connected to a 500,000-circ.mil cable ring-bus. Four-way joints connecting one transformer lead and one street main to the bus are used wherever possible. Services may be tapped off of this bus or directly from the street mains along the block.

Primary supply to the network will be four 12,000-volt feeders, originating in two substations. Each substation receives energy from both of the

[*Continued on page 104*]

What Type Supervisory

Factors of Distance, Number of Units, Available Channels, Degree of Control, Carrier vs. Metallic Circuit Enter to Determine Choice of Installation

In making a decision on a supervisory system consideration has to be given to a variety of factors, and not all of these point to one of the major available schemes. Distance, number of controlled points, number of channels available or required are all involved. Herein is analyzed the weight of each of these influences, and further consideration is given to the matter of speed of action, something quite important in emergencies when "orders" have to be given in quick succession and "answers" received promptly.

By W. P. SIMPSON
General Electric Company, Philadelphia, Pa.

IN GENERAL, the choice of a supervisory system is governed by three major factors: The number of units to be controlled or supervised, the available transmission channels between the dispatching point and the outlying station and their cost, and the type of operation desired. Other factors, such as the number of control devices required and their maintenance, will have their influence on the choice. Knowing these, one can select the supervisory system which will best meet his requirements by comparing the relative merits of those now available.

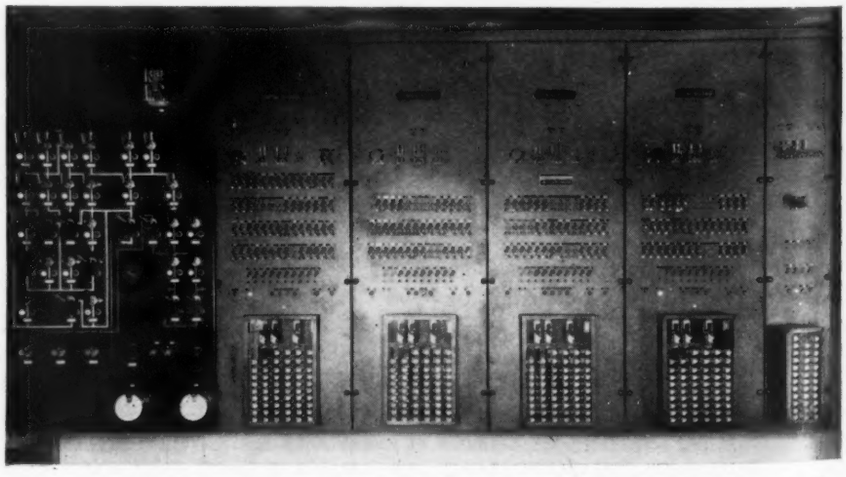
There are in use at present two basic types of supervisory systems. One depends upon a step-by-step synchronizing of equipment in the dispatcher's office with that in the remote station. The other depends upon a code (or polarized code) of current impulses to select the desired unit at the remote station.

Theoretically, there is no limit to the number of units which may be controlled or supervised at any one location by either system. There is, however, a practical limit, which will be pointed out later under type of operation. The synchronous system has been built in installations having as many as 115 points.

Number of controls and indications obtainable in a code system varies with the type selected. One of the larger systems for panel mounting has been built for as high as 64 points of control and indication. Another type is designed for the control and indication of from one to five breakers or equivalent units. The latter has a dispatcher's office cabinet suitable for desk mounting and the equipment at the remote station may be mounted in a small outdoor, weatherproof housing. Needless to say, the limiting of this system to five points of control and indication materially reduces its cost.

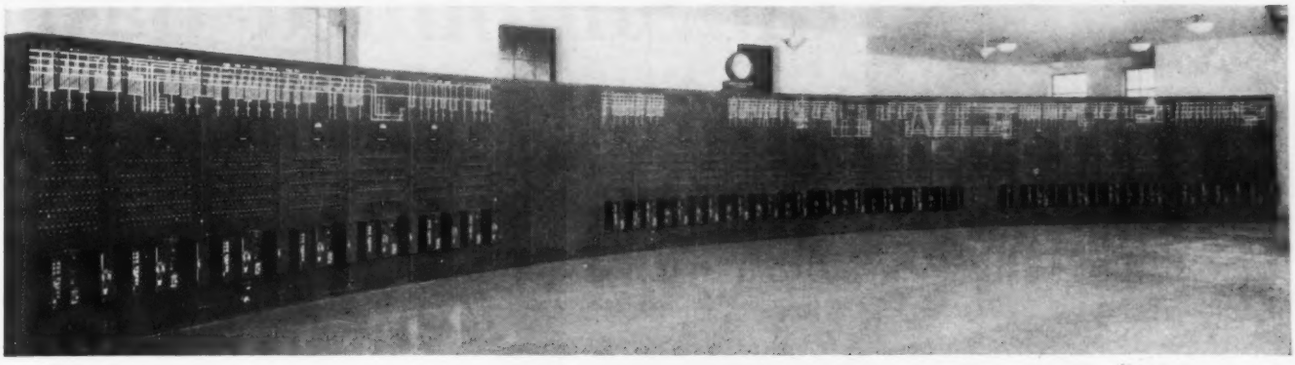
We meet with one of the major differences between the synchronous and code systems in the transmission channels required. In the synchronous system two line wires are necessary for the synchronizing of the stepping operations. To avoid interference with this synchronizing and to obtain instantaneous control and indication, two additional wires, making a total of four, are required. The code system uses two line wires between the dispatcher's office and the outlying station, or one carrier-current channel superimposed on telephone conductors of power line conductors, providing the equivalent of these two wires. The range of both systems is 40 miles over No. 19 gage copper wire, or 60 miles over No. 16 gage copper wire. The use of a carrier-current channel for the code systems, of course, greatly extends the range over which this supervisory can be economically operated.

From the viewpoint of transmission channels alone it would seem that the code system using only two line wires, or a carrier channel, is the most desirable. However, recall for a moment the development of supervisory systems in general. The forerunner of supervisory control was remote control by direct wire to each controlled



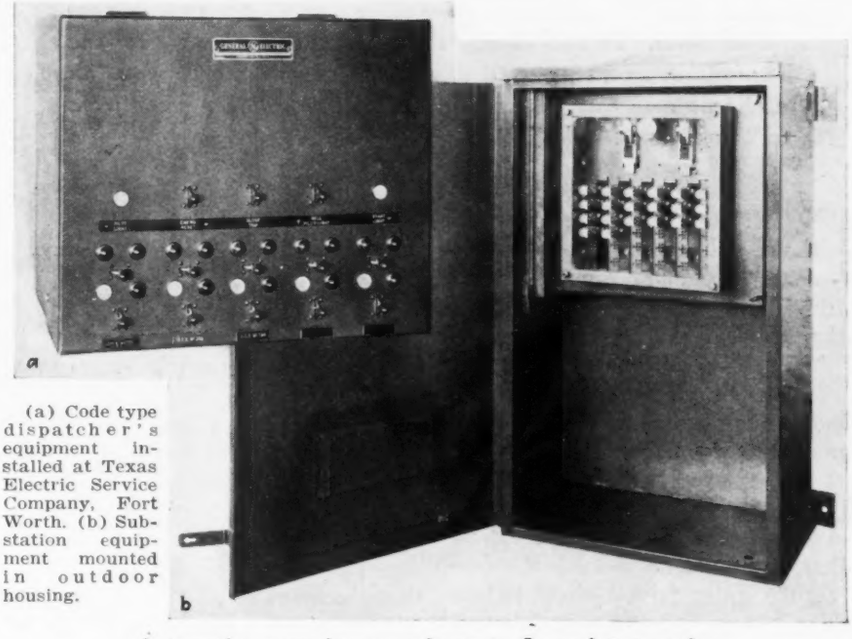
Two-wire code type of supervisory equipment in power director's office of the Pennsylvania Railroad, main line electrification, Baltimore, Md. (partial view)

System Shall Be Chosen?



World's largest supervisory control installation

Four-wire synchronous supervisory equipment in the power dispatcher's office of the City of New York Independent Subway System for rectifier and track feeder control.



(a) Code type dispatcher's equipment installed at Texas Electric Service Company, Fort Worth. (b) Substation equipment mounted in outdoor housing.

Automatic supervisory equipment, five-point two-wire

device. The control equipment was of the simplest nature. This was satisfactory, and still is, for distances in the order of 1,000 ft., but where the distance is in terms of miles it becomes impractical. Supervisory control meets the demand for control and indication over a minimum number of conductors, at the necessary and justifiable expense of more complicated control circuits and a greater amount of equipment.

By utilizing four line wires in the operation of the synchronous system each line wire is called upon to perform only one duty (synchronize, control, indicate and common return) and the equipment required to transfer the control and indication wires from one substation unit to another is very small. However, when a further reduction is made in the number of line conductors, as in the code systems, the circuit design is necessarily more complicated and the number of devices required to supervise a given number of substation units is increased due to the transfer equipment required to allow selection of a point, control of a unit and indication of this unit all over two line wires.

Although the code system has not sacrificed the unexcelled reliability of the synchronous system, it is obvious that when we increase the complexity and size of an equipment we also increase its maintenance. It is an interesting fact that up to the present the four-wire synchronous systems still remain the simplest in both circuit design and amount of equipment used. These systems are, therefore, preferred when the additional conductors are available and result in economic advantage due to the simplicity of the circuits and the lower maintenance. This statement, of course, assumes that the synchronous system also meets the requirements of the other governing factors. The code system is used when the expense of the additional conductors is the determining economic feature or when the conditions favor a carrier channel.

Speed of operation important factor

Under "type of operation," speed is of primary importance. One of the four-wire synchronous systems steps from point to point at the rate of about ten points per second. The time of selecting the device associated with the first point is therefore only a fraction of a second, and for the unit controlled on the 90th point it is approximately nine seconds. It is for this reason, that of time required for the last point, that the number of units controlled or supervised by this type of system is usually limited to around 100. From the standpoint of speed of indicating automatic operations this system is remarkably fast. Should all the automatic devices in any outlying station containing 100 units change their positions simultaneously the entire station would be checked in approximately ten seconds.

[*Continued on page 106*]

Rate Results Analyzed on Simplified Basis

Plot of Cumulative Consumption on Probability Scale Makes Projection of Rate Changes More Accurate and Expeditious

An earlier article (see "Electrical World," Feb. 15, 1936) showed how to convert consumption curves to approximate straight lines. In this article the same author shows how the technique can be employed to disclose vividly the progress an intelligent rate can promote in shifting consumers away from the "starvation blocks."

By E. S. ZUCK
United Gas Improvement Company, Philadelphia

IN THE first installment it was shown that not only does the residence consumption analysis itself follow closely the frequency or probability law, but also that the blocking of the analysis follows the same law. It is possible, however, to develop these results further. From an inspection of the curve in Fig. 1 it is obvious that if the values at 10 and 100, or slightly above or below, are known, and also at one or more intermediate points, it would be possible to construct the entire curve without serious error. Now most block rates break at one or more points between 10 and 100, as, for instance, the following rate:

First	30 kw.-hr. at 8 cents per kw.-hr.	
Next	30 kw.-hr. at 5 cents per kw.-hr.	
All over	60 kw.-hr. at 3 cents per kw.-hr.	
Minimum charge		$1.00

Many utilities having such rates keep records each month of the total number of kilowatt-hours or M cubic feet of gas billed at each price step of the rate and also the number of kilowatt-hours or M cubic feet billed in minimum charges, the number of minimum charges and total number of bills. These records are used each month to verify or prove the total billing of customers' accounts. With this information available, in this particular case three points of the curve can be easily determined, these points being at 12, 30 and 60 kw.-hr., respectively. The point at 12 is determinable because there is a maximum of 12 kw.-hr. given for the minimum charge of $1.

However, since it has been found by experience that the upper part of the curves may deviate from a straight line, and further may either turn to the right or left, it is necessary that the value at 100 be determined, unless there happens to be a breaking point at or near 100. This requires that the number of bills for more than 100 kw.-hr., or 10,000 cu.ft. be known, and also the number of kilowatt-hours or M cubic feet in these bills. If a change in price at some point over 100 kw.-hr. or 10,000 cu.ft. is desired, an analysis of these bills is necessary. Since, however, the number of bills over 100 kw.-hr. or 10,000 cu.ft. is small and generally does not exceed 10 per cent of the total electric bills and 2 per cent of the total gas bills, it is clear that the work in analyzing these bills is not at all burdensome.

Curves always similar

The author has calculated and plotted a considerable number of these curves for different utilities, both electric and gas, the figures plotted being based on actual analyses. In all cases so far encountered the curves have shown the same characteristics. Some of them are either straight lines or very nearly straight from 10 to 100, which is the range that is most important. Most of the curves at the lower end droop gently downward from about 20, while at the upper end, usually at about 80, they begin to deviate from a straight line by curving either to the right or left. Beyond 100 the results are uncertain, although if an analysis be made of the consumption amounts over 100, there is no reason why the plot cannot be carried as far as desired. Beyond 100 the deviation from a straight line is usually quite pronounced.

But what about the accuracy of such a method? In order to test the accuracy the plan adopted was as follows: Based on actual analyses, the blockings were determined at 10 or about 10, at 100, and at one or more intermediate points, depending on the particular rate in effect at the time the analysis was made. The curve was then plotted, and from it the intermediate values between the plotted points were determined. The curve values were then compared with the actual values calculated from the analysis. This has been done for a number of analyses, and it has been found that the curve values compare very favorably with the actual values. The maximum deviations are shown below in per cent of actual, based on the study of twelve analyses, both electric and gas. Figures of deviation at scale points of 10 and 100 have been omitted, since these were points based on the actual blocking of the analyses. It should be noted that the deviation is greatest at 20, and from that point on the deviation drops to 1 per cent and less. These errors do not appear to be serious, since the effect of the

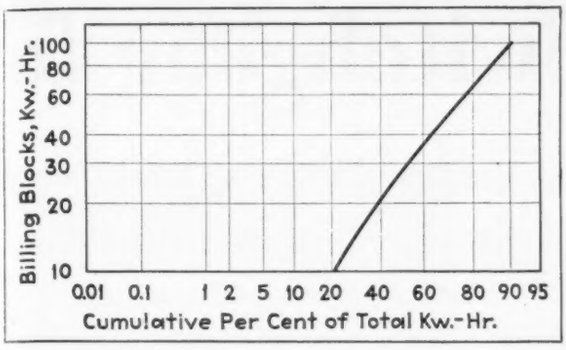


Fig. 1—Special co-ordinate paper rectifies cumulative consumption curve

The horizontal scale is a "probability" one to take out the curvature that would occur if made linear.

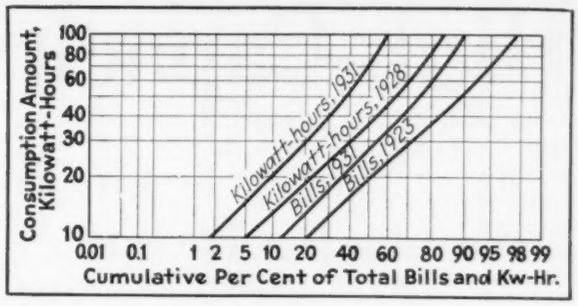


Fig. 2—Probability plot facilitates comparative study of consumption progress

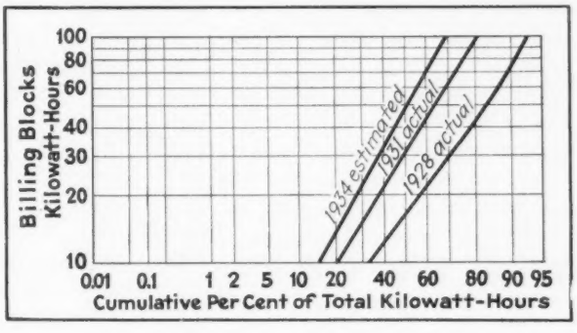


Fig. 3 — Estimated curve readily drawn for future year

calculation of revenue losses would be small.

Scale Point	Per Cent Deviation of Curve from Actual: Maximum Plus	Maximum Minus
20	2.0	1.4
30	0.7	1.1
40	0.7	1.0
50	0.2	0.4
60	0.5	0.6
70	0.5	0.8
80	0.5	0.7
90	0.4	0.3

Prorating leads to inaccuracy

In one important respect data obtained from the monthly billing records would be more accurate than the same data from an actual analysis. When making an analysis the treatment of prorated bills gives considerable trouble. It is normal in actual billing of customers' accounts to find in any month a considerable number of consumptions which cover irregular billing periods; *i.e.*, more or less than an even month. The usual procedure in billing is to prorate these consumptions. When making an actual analysis it is difficult to pick out these irregular consumptions and treat them in the analysis in the same manner as they were treated in actual billing. The monthly billing records showing the number of units billed at each price reflect accurately the proration of these irregular consumptions.

Another development of the probability curve method just described is the possibility of keeping actual analyses up to date by means of data secured periodically from the billing department. Suppose an analysis were made in 1930 for the purpose of making rate changes in 1931, and that rate changes are again proposed in 1935. The question is whether to make a new analysis, and if consumption has increased to a considerable extent a new analysis is usually required. It can be readily seen that the probability method may be used to construct a new analysis and requires data which are usually easily available from the billing records. The old analysis serves then as a guide in determining the general shape of the curve representing the new analysis. In Fig. 2 the curves show two actual analyses, one of which was taken in 1928, while the other was taken in 1931. Average consumption had in the meanwhile increased approximately 64 per cent. The curves of both bills and kilowatt-hours for the two periods under consideration show practically the same general characteristics, but indicate clearly that most of the growth has occurred in the upper brackets of consumption.

In Fig. 3, three curves of cumulative per cent billing blocks are shown, one for the analysis of 1928, one for 1931 and the third an estimated curve for 1934. The latter was plotted from four known points obtained from available billing data. In this particular case the number of customers has increased comparatively little, but use has increased very greatly. So that the calculation of the values for plotting the curve for 1934 shown in Fig. 3 may be clearly understood the following example is of interest:

Rate

First 35 kw.-hr. at 9 cents
Next 35 kw.-hr. at 6 cents
Over 70 kw.-hr. at 3 cents
Minimum charge $1.00

Data Taken From Billing Records:

1. Total number of kilowatt-hours billed 1,743,092
2. Total number of bills 24,262
3. Number of minimum bills 3,311
4. Kilowatt-hours in minimum bills 53,394
5. Kilowatt-hours billed at 9 cents 659,662
6. Kilowatt-hours billed at 6 cents 329,982
7. Kilowatt-hours billed at 3 cents 700,054
8. Number of bills over 100 kw.-hr. per month 4,637
9. Kilowatt-hours in bills over 100 kw.-hr. per month 1,007,346

Derived Data:

A. Maximum kw.-hr. in a minimum bill $1.00 divided by 9c. 11
B. Number of bills over 11 kw.-hr. No. 2 minus No. 3 20,951
C. First 11 kw.-hr. in bills over minimum A times B 230,461
D. First 11 kw.-hr. in all bills No. 4 plus C 283,855
E. First 35 kw.-hr. in all bills No. 4 plus No. 5 713,056
F. First 70 kw.-hr. in all bills E plus No. 6 1,043,038
G. First 100 kw.-hr. in bills over 100 kw.-hr. per month No. 8 times 100 463,700
H. Kilowatt-hours over 100 kw.-hr. in bills over 100 kw.-hr. per month No. 9 minus G 543,646
I. First 100 kw.-hr. in all bills No. 1 minus H 1,199,446

Values to Be Plotted:

J. Per cent total kw.-hr. in first 11
D divided by No. 1 $\frac{283855}{1743092} = 16.3\%$

K. Per cent total kw.-hr. in first 35
E divided by No. 1 $\frac{713056}{1743092} = 40.9\%$

L. Per cent total kw.-hr. in first 70
F divided by No. 1 $\frac{1043038}{1743092} = 59.8\%$

M. Per cent total kw.-hr. in first 100
I divided by No. 1 $\frac{1199446}{1743092} = 68.8\%$

[*Continued on page 108*]

High-Capacity Switchgear for

Heavy Currents Require Heavy Mechanisms, Raising Problems of Design Not Present in Usual, Lighter Construction Breakers

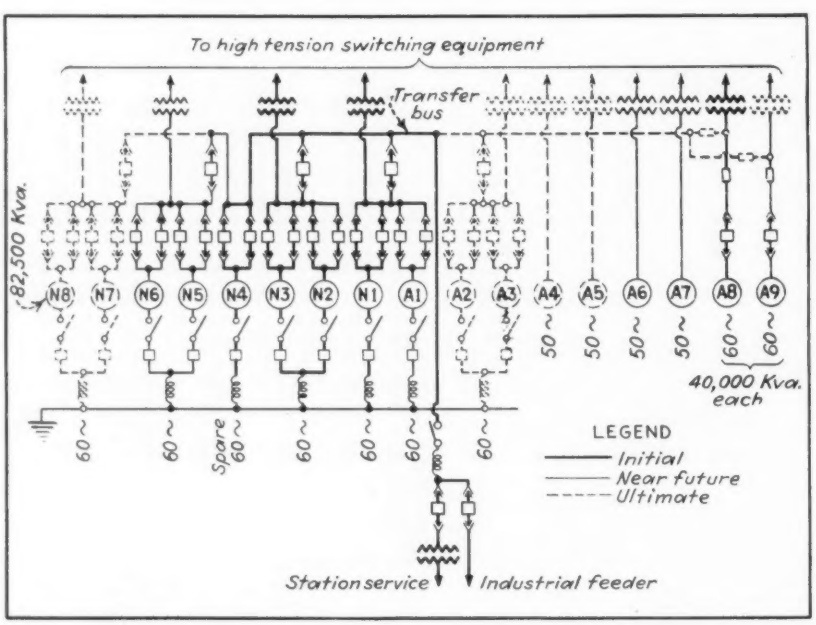
By J. D. GREENSWARD
Sales Engineer,
Allis-Chalmers Manufacturing Company

OIL CIRCUIT BREAKERS for the Boulder Dam-Los Angeles system must be capable of interrupting 2,500,000 kva. at 16.5 kv., three-phase. This means the interruption is approximately 90,000 amp., requiring a special design of arcing tips combined with the expulsion port arc extinction principle. As seen from the section and other illustrations the main studs of the oil circuit breaker incorporate both the disconnect contacts and the main contacts of the unit and are supported on a massive top plate made of non-magnetic material.

The motor-operating mechanism mounted at the end of the three-phase breaker is mechanically trip free in any position of its stroke and is of a very special design because of the necessity for rapid motion of the heavy parts for closing and opening the breakers. Four motors are used, directly connected to the large gear which operates the main toggle of the mechanism. The large gear rotates 360 deg. for each operation, but only the first 164 deg. are required for closing the breaker; the remainder of the movement is for resetting ready for the next reclosure. Over-all closing time from the time the motors are energized until the main contacts touch is approximately 20 cycles; six more cycles are required for the relays, making a total over-all time of 26 cycles from the time the control switch is energized. This is considered quite a short time for closure of an oil circuit breaker of this size, especially when no springs, clutches, etc., are incorporated in the design, and the current required for closure is less than half of that for an ordinary solenoid-operating mechanism.

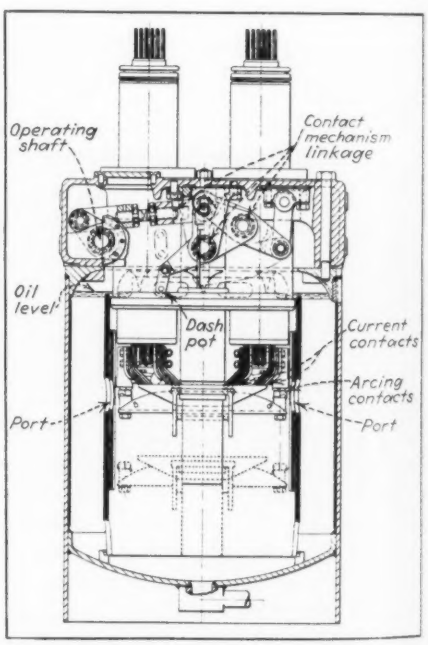
Because of convenience and saving in space, the double-circuit-breaker unit required for each generator is built with a common framework for the two circuits. Cross-connecting buses are necessary to provide for connections to the incoming generator leads and out to the transformer bank. Because of the proximity of these high current carrying conductors to the framework the upper structure is built mostly of non-magnetic material to prevent undue heating of the structure. The top framework braces and supports the buses and supports the oil circuit breaker and, therefore, is made very rigid to prevent undue deflection during the shocks of short-circuit interruption.

For ease of erection, the complete upper structure, with its cross-connecting buses, disconnecting contacts, elevating mechanism, motor and auxiliary switches, is shipped as a complete assembled unit. Because of the extreme width of these units and the possible interference with other trains special handling was necessary in shipment.



Switching scheme provides two oil circuit breakers for each generator

Either generator will handle the total output. A transfer bus switch allows load to be shifted so that any generator may be shut down for inspection and maintenance.

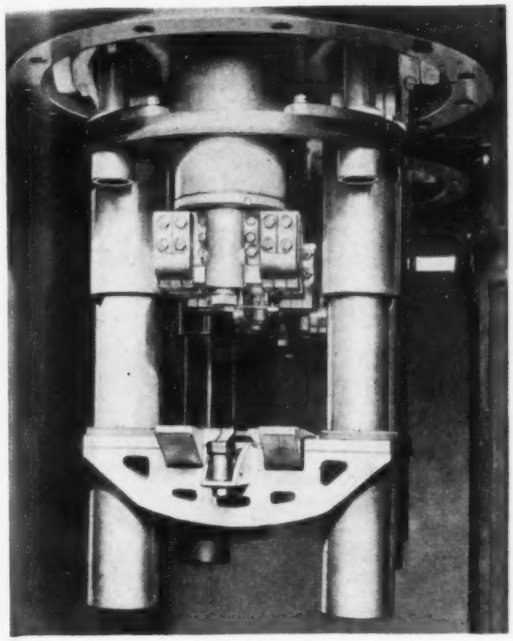


Turbulence principle of arc interruption

The first small separation of the arcing contact causes gas to be generated by the arc. These contacts being in an inclosed chamber, the gases produced immediately cause this chamber to be under pressure, the only relief of which is through the expulsion ports opposite each set of arcing contacts. The movement of gases and volatilized oil from this chamber must necessarily be through the ports located adjacent to the point of arcing. Turbulence caused by this violent movement at the point of arcing deionizes the arc to such a point that the arc interruption is much quicker than experienced on ordinary plain break oil circuit breakers and the result is a comparatively minor deterioration of oil and arcing contacts.

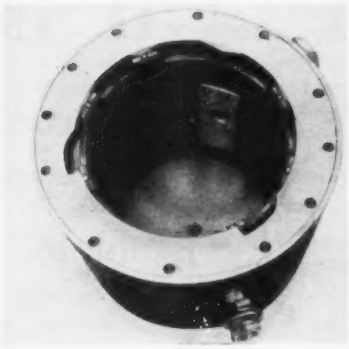
Easy Maintenance

Control of such large blocks of power as will be generated at Boulder Dam presents problems not only of interrupting the heavy short circuits that may occur on a system of this size but also of flexibility and ease of operation, easy and quick maintenance of the circuit breakers and bracing of all conductors to withstand stresses imposed during short-circuit conditions. Metal-clad switchgear was selected for Boulder Dam by the U. S. Reclamation engineers as offering the best solutions to these problems.



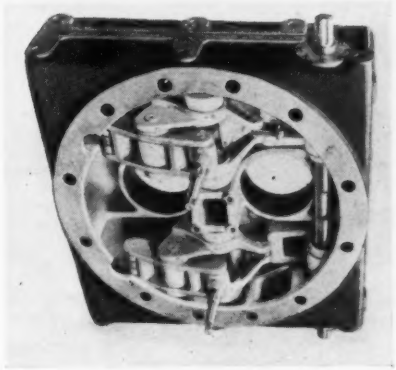
Accessibility and strength provided

The initial transient period of short-circuit produces a major duty on the operating mechanism, linkages and lift rod assembly properly to control the main contact blade with its arcing contacts. To solve this problem only high-strength metals were used in tension throughout the linkages and lift rod assembly. Where insulation is necessary the stresses imposed on it are only in compression, making a very strong opening and closing mechanism. No insulation is used in tension as in the lift rods in conventional breakers. Instead of one lift rod per pole, two are used, forming a bridge for raising and lowering contact blade of breaker. When tanks are dropped the circuit breaker is raised to the disconnect position, the lift rod and contact assemblies are easily accessible.



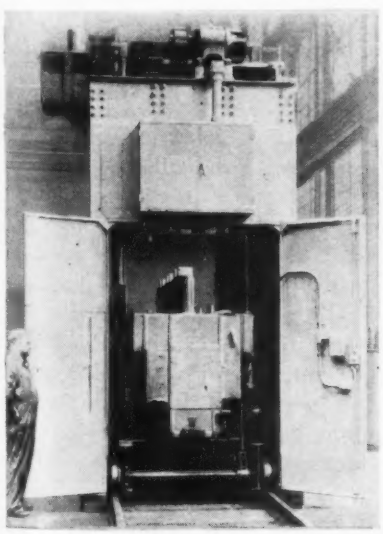
Design involves double tank

Below the top plate are two completely inclosed chambers, one within the other. The compression chamber contains the main contacts and arcing contacts, both moving and fixed, and the special lift rod assembly necessary for a circuit breaker of this size. The only openings between the internal and external chambers are the two ports opposite the two arcing contacts. The internal chamber is completely submerged and filled with oil, having no air chamber in it. The external chamber, being the tank of the oil circuit breaker, is filled with oil to a point just above the top of the internal chamber. The air volume to absorb the shock during the interruption is thus partially in the top of the tank, but is mostly incorporated in the massive box type top plate from which the tank is supported.



Top plate assembly is non-magnetic

The massive contacts needed for a 4,000-amp. oil circuit breaker and also the weight necessary to obtain the required strength of moving parts made desirable the incorporation of oil dashpots in each lift rod assembly to bring these heavy parts to rest without shock both in opening and closing. The straight line linkage motion in the top plate is all made of non-magnetic materials because of its proximity to the 4,000-amp. conductors.

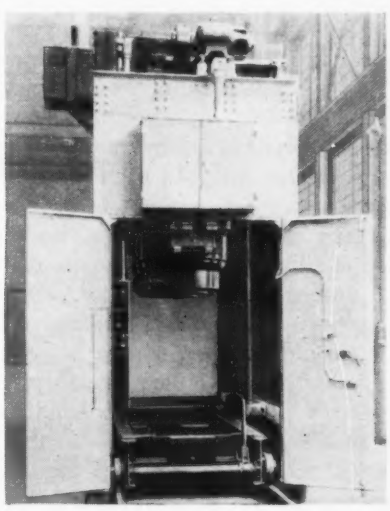


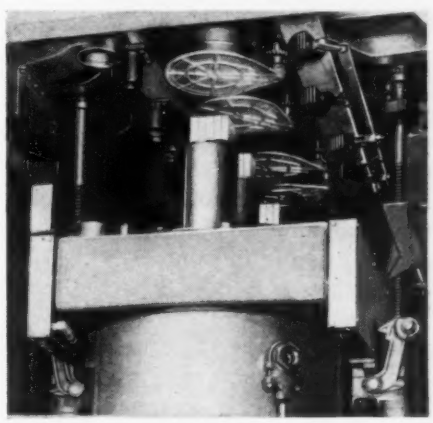
Easy handling a feature

A complete three-phase oil circuit breaker, with its operating mechanism is brought into the fixed portion of the metal-clad unit with a transfer truck, which is operated on standard gage rails. This transfer truck allows the interchanging of breakers, as they are all built to jig and will fit in any fixed portion. A small door incorporated in the main door provides access to the control cabinet for raising and lowering the oil circuit breaker between the operating position and disconnecting position. When the unit is in the disconnect position, the main doors can be opened and separate push button must be used to drop the breaker down on to the truck.

Breaker in operating position ready to go

The circuit breaker is raised into operating position (closing disconnects) by a self-contained motor-operating mechanism on the unit. Traveling nut limit switches geared to the mechanism provide interlocks and automatic stop for the proper positions of the oil circuit breaker. Push-button automatic control is provided for either opening disconnects or closing disconnects and the unit is built of sufficient height so that the circuit breaker tanks can be left on the truck and the breaker raised to the disconnect position for inspection. Interlocks are provided to prevent the raising of the circuit breaker to its operating position unless the circuit breaker is open and all tanks securely bolted in place.





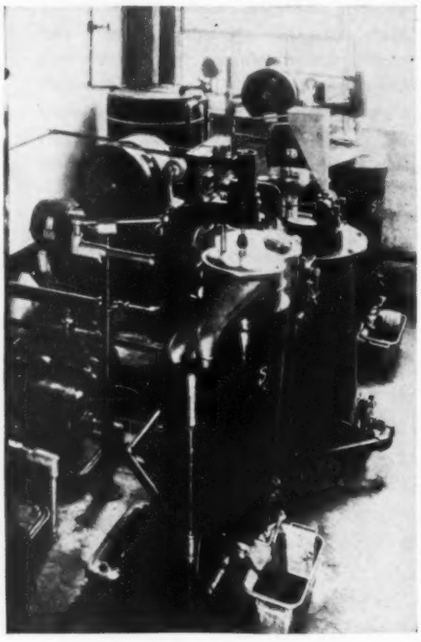
Locks and interlocks safeguard maintenance

The safety devices incorporate the usual standard interlocks of metal-clad switchgear, and in addition the circuit breaker must be in the disconnect position before it is possible to gain access to the housing of the switchgear. As shown in this rear view, the disconnect position includes interposed metal barriers between contact members, which automatically close when the breaker is withdrawn to the disconnect position. This view also shows the disconnect contacts, exhaust vents, guide pins and ground contact, which all engage when the breaker is raised to the operating position.

Insulating Oil Reconditioned at Low Cost

Chemical Process Used With Success — Oil Classification Aids in Treatment — Examples of Treatment Given

By L. BASKETTE
Chemist, Southern California Edison Company, Ltd.



Centrifuges and filter equipment used in oil reclaiming process

THE question of when, if ever, to discard insulating oil which has given years of service and which, though burned or oxidized, still has some value is a matter for decision by every electrical utility.

However carefully the original oil may have been selected, changes do occur in its condition after prolonged service. The degree to which the oil changes depends upon its type and source, the amount of oxidation during service and any contamination from moisture from varnished windings or from impurities picked up in storage or in handling and which are either in suspension or in solution in the oil.

Impurities suspended in the oil and the moisture present can be removed quite effectively by the usual methods of centrifuge, filter press or combination. The impurities in solution, however, are unaffected by such treatment and these accumulate as the oil is repeatedly filtered and reused until such time that the oil has quite obviously deteriorated as compared with its original condition and as evidenced by a dark red or black appearance, high neutralization value, increased carbon residue, low resistance to emulsion and by sludge formation in oxidation tests.

Use of conservator tanks on transformers and of inert-air equipment has prevented oxidation to a large extent, but at the central oil conditioning plant of a utility much of the oil received is sludged or from burn-outs or overhaul jobs and contains tarry and resinous bodies in solution which cannot be removed by filtering or centrifuging.

The Sharples oil-processing unit has been adopted by the Southern California Edison Company as a means of reconditioning and putting into service a stock of such old insulating oil which has accumulated over a period of years. Treatment of insulating oil by an alkaline wash and contact with clay is not particularly new, but it offers a means of putting the oil into usable condition by neutralizing all organic acidity that has developed in service, restoring the resistance to emulsion and decreasing the sludging tendency of the oil.

A summary of the method of classifying oils in use by this company will show how this oil had accumulated. For a long period of time an endeavor was made to keep separate the different brands of oil in different manufacturers' equipment. As each manufacturer had several brands this entailed duplicate piping and storage, and in spite of efforts to the contrary, eventual mixing of oils occurred. With the advent of so-called universal oils which could be used in any make of equipment and in either transformers or circuit breakers the oil handling was considerably simplified, but there was still the problem of used oils and keeping separate the oil in very good condition as compared with that of very poor condition. The classes of oil then became four in number:

New oil—For use in high-voltage equipment, both circuit breakers and transformers.

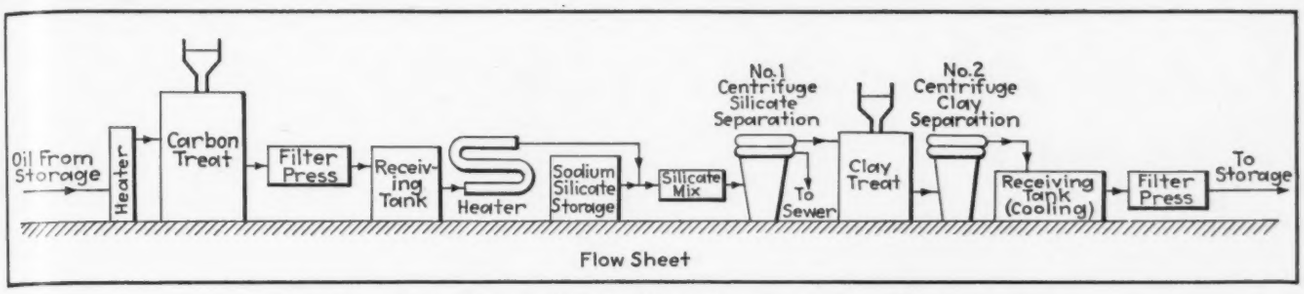
No. 1 oil—Transformer oil which had been in service but only slightly oxidized, acidity less than 0.5 mg. KOH per gram, low carbon residue, and withstanding at least three-day oxidation test at 120 deg. C. without sludging.

No. 2 oil—Transformer oil considerably oxidized and sludging, acidity up to 1.0 mg. KOH/gram, or more, poor resistance to emulsion, loses dielectric strength.

No. 3 oil—Used circuit breaker oil.

The policy had been to use the poorer conditioned oil in lower voltage equipment rather than junk it. Conditions of operation became such that all the No. 1 oil was used up, while the inferior oxidized No. 2 oil gradually accumulated until the problem was faced of using this oil in higher voltage equipment and as make-up oil generally, thus reducing the high quality of the oil in service or, as an alternative, to purchase new oil even though having in storage an idle 100,000 gal. of insulating oil that could possibly be put into good condition by proper treatment.

An investigation into methods of treatment showed that a simple contact with activated carbon or with clay at high temperature, much the same as the final treatment given the oil in its original refining, would remove the oxidized impurities and essentially restore it to the original con-



Flow sheet of Southern California Edison Company's oil reclaiming plant

dition. The improvement in resistance toward sludging was of particular interest.

In the study of the sludging characteristics of insulating oil, the transformer oil life-test apparatus developed by the General Electric Company was used. This is simply an oxidation machine in which the test samples (500 c.c. of oil in 600-c.c. glass beakers) are supported on a revolving platform in an insulated chamber and maintained at 120 deg. C. ±1 deg. while air is passed across the surface at a rate of 1.5 cu.ft. per hour. Samples of oil (10 c.c.) are withdrawn at 24-hour intervals until the oil has reached a stage of oxidation where the sludge can no longer be held in solution, but begins separating as a heavy deposit which shows in the test samples after standing and centrifuging. The time in days to the first formation of visible sludge is termed the life test of the oil.

Samples of new insulating oils tested in this machine have shown results varying from three to 30 days' life test. Sludged and oxidized oils fail in one day, but when treated with acid and clay or with a sufficiently large amount of activated clay alone (more than 1 lb. per gallon) can be brought to a condition resisting sludging for more than a 60-day life test.

Treatment of old oil by the Sharples processing unit accomplishes much the same result, the acidity of the oil is reduced to 0.1 mg. KOH per gram of oil, the steam emulsion separation (A.S.T.M. D157) is 30 seconds and the life test four to ten days, depending on the quantity of activated carbon and clay used in treatment.

The process has three stages and the recommended procedure is: First, an activated carbon treatment at 2 per cent by weight; second, a 2 per cent sodium silicate wash at 30 per cent by volume, and, third, a final clay treatment at 2 per cent by weight of the oil.

The oil to be treated is passed through a heater to the carbon tank, where the activated carbon is added mixed and allowed to settle; the oil is drawn off by a float filtered through a press to a receiving tank, then pumped with addition of silicate solution to a high-speed paddle mixer and separated by the first centrifuge; the alkaline wash goes to the drain, the clear neutral oil flows to a mixing tank and is treated with clay fed through a hopper; the clay is separated by the second centrifuge, the finished oil is pumped to a receiving tank and after cooling is filtered to storage, thus completing the treatment. The temperature of the oil is maintained at 185 deg. F. throughout the process.

Pre-treatment with carbon is necessary in order that the oil may be successfully washed with sodium silicate. This is especially true of transformer oils of acidity greater than 0.5 mg. KOH per gram, because without the carbon treatment such oils form an emulsion which cannot be readily separated by the centrifuge. The clay treatment after the silicate separation removes any silicate that may have been carried over and further improves the resistance of the oil to sludging and to emulsification.

Although designed as a continuous process to operate at 150 gal. per hour, it has been found that the pre-treatment with carbon makes practically a batch process of the unit when this treatment is used and with one operator the daily output is about 500 gal.

Used oil in electrical apparatus is a big problem. It comes from many manufacturers and receives many different kinds of service. A system to classify and reclaim used oil should interest all engineers. This story gives practical results on a utility property.

Some oils can be processed without the carbon treatment, but for badly oxidized or burned oils the use of carbon and clay is necessary, and the greater the quantity used the more improvement will result in the sludging or life test. The disadvantage to an excessive amount of these materials aside from the cost is the loss of oil, inasmuch as a minimum of 60 per cent of their weight in oil is retained.

The cost of treatment should average below 6 cents a gallon for the silicate, clay, carbon, power, labor and repairs. A quantity of oil has been treated with good results using carbon and clay at 1 per cent by weight and showing per 1,000 gal. treated:

Loss of oil, per cent	3.2
Carbon at 10c./lb.	$6.80
Clay at 3c./lb.	1.80
Silicate at 21c./gal.	2.65
Power at 1 ct./kw.-hr.	3.50
Labor 16 man-hours	16.00
Total direct cost	$30.75

Oil treated in this manner has shown the following results:

	Before Treatment	After Treatment
	Dark red opaque	Yellow clear
Color viewed in 4-oz. oil bottle		
Viscosity Saybolt at 100 deg. F. sec.	60	59
Acidity mg. KOH/gm.	0.75	0.10
Carbon residue per cent	0.07	0.03
Emulsion test, A.S.T.M. (seconds to separate)	130	30
Oxidation test (days at 120 deg. C. to first formation of sludge)	—1	4
Dielectric test (0.1-in. gap 1.0-in. disc)	25 kv.	35 kv.

One of the principal advantages in using a chemical process for the treatment of used insulating oils is where the same type of oil is used for all equipment and the oil from circuit breakers can be reclaimed by the process for use again in transformers. With such a process there is no occasion for junking insulating oils, inasmuch as even badly oxidized or burned oils can be brought back to a renewed state of usefulness and stability.

Linear Depreciation Unsuited to Hydro

Infrequent Additions, Sustained High Efficiency, Stable State of Art, Long Life of Development All Point Away From Regulatory Urge for Straight-Line Method

By R. L. THOMAS
General Superintendent Pennsylvania Water & Power Company, Baltimore

PARTICULAR conditions should be considered in determining whether a public utility company's depreciation accounting method, rates and annual charges to operating expense are just and reasonable. A plan which is suitable for one situation may be inequitable and discriminatory with respect to both the utility and the ratepayers in another case. In the literature on depreciation there has been much theorizing in the abstract, but very little analysis of cases and consequences.

Data on this problem have been compiled during the comprehensive studies by engineers and accountants of the Safe Harbor Water Power Corporation, which recently built and is now operating a large low-head hydro-electric development* on the Susquehanna River with a present capacity of 255,000 hp. In making these studies the Safe Harbor company had the benefit of 25 years' experience of the Pennsylvania Water & Power Company at the Holtwood development on the Susquehanna River 8 miles below Safe Harbor.

Safe Harbor Water Power Corporation is solely a hydro-electric generating company. It owns neither transmission nor distribution system, although its project does include step-up transformers. In general, conditions affecting physical depreciation at Safe Harbor are not materially different from those at other large modern low-head hydro-electric developments.

An inherent characteristic of modern hydro developments which has an important bearing on depreciation policy is the fact that *over a long period of years major capital additions are few and far between.* The greater part of the investment for the ultimate development must be made initially. An additional generating unit may be added occasionally, but the tendency in recent years at new run-of-river plants has been to install initially enough turbine capacity to utilize all of the stream flow during the greater part of an average year. This is usually necessary to effect economic co-ordination with steam generating stations and to justify the development. Consequently it is obvious that major additions can occur relatively seldom in a long period of years. Because of this characteristic hydro-electric plants have aptly been called a "static" type of development.

In the past nearly all depreciation plans and discussions of the subject have been predicated on the assumption that most, if not all, of the annual increase in depreciation reserve could currently and normally be invested in plant. This is not possible in the case of a "static" type of development.

Obsolescence an almost negligible factor

The Federal Power Commission's definition of depreciation includes

"those ordinary losses in capacity for use or service sustained by physical property from obsolescence or inadequacy due either to age, physical change, or supersession resulting from new inventions, discoveries, change in popular demand, or requirements of public authority" (Regulation 16, Section 2).

The Interstate Commerce Commission's definition of depreciation states that it results from causes

"which are known to be in current operation, and whose effect can be forecast with a reasonable approach to accuracy" (177 I.C.C. 422),

and the Interstate Commerce Commission has ruled that

". . . depreciation includes the effect not only of wear and tear and the action of the elements but also of such obsolescence or inadequacy as may be foreseen, but not unusual and unforeseen losses from sudden obsolescence, fires, or other like casualties; . . ." (177 I.C.C. 390).

The definition of depreciation recently adopted by the Public Service Commission of New York includes loss from causes

"the effect of which can be forecast with a reasonable approach to accuracy" (Uniform System of Accounts, p. 8).

Under these definitions it is believed that *obsolescence or inadequacy is almost negligible in determining depreciation at a modern hydro plant* except as to certain minor auxiliary equipment. In other words, there is no "ordinary" loss from obsolescence or inadequacy to be expected, and there are no such causes "which are known to be in current operation, and whose effect can be forecast with a reasonable

*See ELECTRICAL WORLD, December 5, 1931.

approach to accuracy." It is realized that these are challenging statements, but they are based on an extensive investigation.

Hydro-electric generation on a large scale is only about 40 years old. During such a development period one would naturally expect a good deal of obsolescence and supersession to occur. The surprising thing is not the fact that some generating units and minor plants have been abandoned or replaced because of obsolescence or inadequacy, but the relatively small extent of such retirement. In spite of all the advances in the art, *there are many plants and units in operation which are from 20 to 40 years old.* Every abandonment or replacement of generating units on account of obsolescence or inadequacy has been brought about by the possibility of accomplishing one or more of the following:

(a) Improvement in efficiency.
(b) Increase in capacity.
(c) Increase in utilization of stream flow.
(d) Increase in utilization of the available natural head or fall.
(e) Elimination of excessive maintenance cost.
(f) Change in frequency.

It is extremely unlikely that any one or more of these factors will cause abandonment or replacement of a modern hydro-electric development or generating units therein. The maximum efficiency of hydraulic turbines is above 90 per cent and with the adjustable blade turbine a very flat efficiency curve is obtained. The maximum efficiency of generators is around 98 per cent and of transformers it is better than 99 per cent. As perfection can never be attained, it is obvious that *there is very little room for improvement in efficiency.*

Plants often fully developed at the outset

Since the efficiencies are already so high, the only manner in which capacity can be increased materially is to utilize more of the stream flow. But, as pointed out above, the site is generally already developed far beyond the median flow or even the mean flow. Furthermore, provision is often made in excavation and foundation structures for additional generating units, and if more capacity or utilization of more of the stream flow is needed or can be justified, it will be economic to install additional units rather than to replace the original units with larger ones, even if the latter is possible.

Full economic utilization of the available natural head has undoubtedly been taken into account in the design of any modern hydro development. In the case of a project which is licensed by the Federal Power Commission, the commission is required by the Federal Water Power Act to insure that the project as planned "will be best adapted to a comprehensive scheme of improvement and utilization for the purposes of navigation, of water-power development, and of other beneficial public uses" (Section 10-a).

Depreciation accounting is a live subject in regulatory circles with many commissions showing a predilection for the straight-line method. It calls for higher sequestration of earnings than sinking fund or retirement accounting. It therefore rises to parallel importance with taxes and load building as plus and minus aspects of well-being among utilities. The inappropriateness of the straight-line method is shown here for hydro generation with pointers to one logical prescription. A subsequent article will present a comparative analysis of the sinking-fund and straight-line method applied to a large modern hydro development.

The reduction of maintenance cost has been studied intensively in connection with the design of modern plants. Change of generating frequency has been a cause of replacements in the past, and in certain existing installations is the potential cause of further replacements, but there is no change foreseen which would make this an obsolescence factor in most modern plants.

In considering retirements for the purpose of decreasing generating costs, one fundamental fact must be remembered. *No property can economically be abandoned or replaced unless the annual cost of the output of the substitute unit or plant, including fixed charges, is less than the mere incremental or operating cost of the output of the existing plant.* The latter is small in any hydro plant. It is for this reason that many hydro units and plants which are old and inefficient and might appear to be obsolete are continued in operation. Many examples might be cited. For instance, there is one hydro plant which contains generating units which went into operation more than 30 years ago, are relatively very inefficient, and when compared with modern standards make poor utilization of the stream flow, head and existing power house space. Nevertheless, when there is sufficient stream flow these units continue to operate 24 hours a day, and of course have priority over the most efficient steam generating plant in the large interconnected system.

It is believed that as long as electric energy is used and is derived from sources of usable energy now known, such as fuel, falling water, the wind, the tides and the sun, and by methods now known, a modern hydro-electric plant will continue in operation.

"Ordinary" obsolescence should be allowed for as a factor in estimating the lives of certain auxiliary equipment.

Protection against extraordinary obsolescence which cannot be foreseen, as, for example, obsolescence caused by a revolutionary discovery or process of converting energy—say, atomic energy—which would cause the abandonment of power plants as we know them, if it is considered necessary at all, involves questions of amortization of investment rather than depreciation.

Long lives of structures and equipment

With obsolescence and inadequacy largely eliminated as factors, the lives of modern hydro structures and equipment will depend for the most part on wear and tear or physical depreciation.

There are no experience data as to how long most of the facilities in question will last, for the simple reason that no comparable structures and equipment have yet worn out. Furthermore, even if there were such data, allowance must be made for progress in the art. Information in text-books and hand-books and other literature is of little value, as it does not seem to be based on recent investigations of experience. In connection with the Safe Harbor studies a compilation was made of life estimates contained in fourteen hand-books and text-books. Estimates for generators range from 12 to 33 years; hydraulic turbines, 21 to 50 years; transformers, 16 to 30

years; reinforced concrete or steel and tile buildings, 25 to 90 years. One of the best and most recent hydro-electric hand-books lumps "all power house equipment" at 20 years. Yet in the United States and Canada there are hydro generating units with an aggregate capacity in kilowatts running well into seven figures which have been in service for more than twenty years, are in excellent condition, and do not represent deferred replacements. In most cases *no estimate can be given that the generating units will or should be replaced at any predictable time.*

In an effort to obtain first-hand information as to actual experience, an engineer of the Safe Harbor Company in 1934 visited fourteen of the older important hydro plants in the central and eastern part of the United States and in Canada. The voluminous report confirms the fact that estimating life expectancy is to a considerable extent a matter of judgment. Nevertheless, it does prove the inaccuracy of much of the published life expectancy data and testifies to the long lives that hydro plants have had and will have.

The selected group of developments included a few, all more than twenty years old, which will undoubtedly be abandoned entirely some time in the future because of failure to use the full available head or to develop the stream flow fully, combined with poor efficiency. As previously pointed out, in considering modern plants we need not be concerned with these factors. Furthermore, this is a type of obsolescence which can be foreseen to a large degree. In fact, the retirement can be planned in advance. The number of service years of the major equipment in the plants inspected are given in the accompanying table.

Age of Equipment in Fourteen Hydro-Electric Generating Plants in 1934

Equipment in Service

Years in Service	Turbines: Number	Turbines: Hp. Total Capacity	Generators: Number	Generators: Kw. Total Capacity	Transformers: Number	Transformers: Kva. Total Capacity
35 to 39	..	.....	10	37,500	10	19,215
30 or more	14	82,000	24	90,000	20	38,430
25 or more	35	317,400	40	223,700	54	121,560
20 or more	102	1,052,900	100	749,450	99	426,160
15 or more	115	1,292,900	113	933,150	116	564,910
10 or more	133	1,868,100	131	1,462,150	151	1,036,160
1 or more	139	2,033,700	137	1,595,150	174	1,388,660

Equipment Which Had Been Retired Prior to 1934

Kind	Number	Total Capacity	Installed	Retired
Turbines	10	50,000 Hp.	1895–1900	1910–1912
Transformers	2	17,500 Kva.	1910–1912	1928–1930
Transformers	2	15,000 Kva.	1910–1911	1912

Comments on Observations With Respect to Generating Units

Turbines—Obsolescene due to causes mentioned above, which as previously stated will not recur in a new plant, seems to be the only phase of depreciation which will determine the ultimate life of any of the turbines examined. One installation of ten turbines made between 1895 and 1900 was found to have been retired after an average service of about fourteen years. There was no evidence even in the oldest machines of depreciation due to wear and tear which is not restorable by general overhauling. It appears that those turbines designed prior to 1914, of which 102 were inspected, will have lives ranging from 40 years up. There is nothing to indicate that the turbines installed during the last 20 years will not last indefinitely with proper maintenance.

There was no instance of wear and tear having caused the replacement of a turbine as a whole. In numerous cases runners have been replaced on account of excessive pitting or low efficiency. In several cases major replacements of turbine parts resulted from serious accidents, such as the destruction of the turbine gates in one case and of the turbine buckets in another case, by timber lodged in the runner. Three cases of scroll case failure were noted. Such accidents are wholly unpredictable and extremely rare and, at least in some instances, the possibility of their recurrence has been practically eliminated by improvements in design.

Generators—The accrued depreciation on the existing generators and the replacement of those retired from service were found to be due to obsolescence, most of which occurred in the project as a whole or in equipment associated with the generators. The generator itself has always been very efficient, and neither improvement of efficiency nor reduction of maintenance cost has been an important factor in causing obsolescence. In certain cases a change in frequency may cause the retirement of generators. Those generators, 40 in number, which were installed prior to about 1910, probably will have lives of from 40 years up, the same as the lives of the connected turbines.

There was no evidence of wear and tear which cannot be remedied by general overhauling. There was no case where a generator as a whole had been replaced on account of wear and tear. Replacement of windings or reinsulating of coils appears to be required after 25 or 30 years on the older generators.

Two plants had been flooded, causing extensive rewinding of generators. In another case a generator failed due to overspeed and also wrecked the adjacent machine. Such failures are not "ordinary" service hazards.

Estimates of life expectancy

The straight line and sinking fund methods of depreciation accounting require estimates of life expectancy. In the case of a hydro-electric plant these estimates at best can be only the roughest sort of an approximation. Mathematical accuracy is impossible.

To illustrate, consider a large low-head hydraulic turbine. Each machine is itself a conglomeration of a multitude of parts. Various metals are included, such as cast iron, cast steel, plate steel, forged steel, stainless steel and bronze. Some parts are stationary; some move continually; others move intermittently. Some parts are embedded in concrete; some are continuously submerged in water; some are continuously in contact with oil; some are exposed continuously to air and some are alternately exposed to water and to air. Most of the parts are massive; a few are small and accurately machined. It is almost inconceivable that a properly designed modern turbine will ever be replaced as a whole and the assignment of a life to the turbine as a unit is only an approximation for the purpose of estimating a reasonable composite plant life and depreciation allowance.

The Safe Harbor engineers reached the conclusion that conservative life estimates of the principal equipment and structures at a modern low-head development, which has been placed in operation and has demonstrated the essential correctness of its design, are about as follows, assuming that separate allowances are made for deferred maintenance as noted below, that the estimates will be reviewed frequently, and that adjustments will be made if and when unforeseen factors should develop:

	Years
Turbines and generators (excluding coils)	50
Transformers (excluding coils), oil circuit breakers and disconnecting switches	40
Switchboards and wiring and station service transformers and lighting equipment	30
Lightning and surge protection and storage batteries	10
Heating boilers, pumps and air compressors	30
Steel crest gates on dam	50
Intake gates, trash racks, gate guides, gantry hoists on dam	40
Steel and concrete operating bridge on dam	100
Steel and concrete skimmer wall	80
Power house steel, concrete and masonry	100
Galvanized steel high-tension line terminal structures	60

The regulations of the Federal Power Commission provide that "depreciation representing deferred maintenance shall be estimated, based upon experience and the best sources of information available" (Regulation 16,

Section 4). This provision of a deferred maintenance component in the depreciation allowance is a convenient method of allowing for periodical major repairs and partial replacements of long-lived equipment. The estimates given above are predicated upon the inclusion in the annual depreciation allowance of estimated amounts which will pay the cost of rewinding the generators and transformers every 30 years; overhauling the turbines every 10 years, and refinishing the floors of outside concrete structures every 20 years. Mass concrete is considered as non-depreciable, but the allowance for deferred maintenance should include a liberal allowance for periodical repairs to exposed concrete.

Strange as it may seem, there is sound mathematical justification for using somewhat shorter lives with the sinking-fund method than with the straight-line method. The reasons will be mentioned in a later article. The figures given above are predicated on the use of the sinking-fund method.

Application of the above figures to the depreciation portion of the Safe Harbor development, using the sinking-fund method with an interest rate of 4.25 per cent, results in an equivalent or composite life of 47 years; that is, the total annuity charged to operating expense, including component for deferred maintenance, is the same as the annuity which in 47 years will accumulate to an amount equal to the total depreciable cost.

Resort to reserve deferred

Generalizations are dangerous. Hydro plants and equipment vary widely as to physical design and economic factors, and it is doubtful whether it is practicable to set up standard life tables or rates to be applied alike even to all plants which seem to fall in the same general class.

It necessarily follows from the rugged, durable character of the principal hydro-electric structures and equipment that for many years the charges to the depreciation reserve will be small. Actual experience at the Holtwood hydro development is cited as an illustration. In spite of the fact that the first five generating units went into operation in 1910-1911, the aggregate charges to the reserve for renewals and replacements for the hydro plant during the entire period up to December 31, 1934, amounted to only $598,488. This is only 2.9 per cent of the total fixed capital in the hydro development at the end of the period. It is only fair to state, however, that deferred maintenance has not been charged to depreciation reserve at Holtwood to the extent proposed above.

T.V.A. Yardstick Becomes "Alphabetical Joy Ride"

Wendell L. Willkie Broadcasts Salient Facts About Muscle Shoals to U. S. Taxpayers, Who Ultimately Foot the Bill

"OUT of the total original investment by the federal government of $125,000,000, $65,000,000 in the [Muscle Shoals] nitrate plants has become valueless, $40,000,000 invested in the power plants has been charged off and millions in possible return lost. No wonder our taxes mount.

"The Tennessee Valley Authority, under the Act of Congress passed in 1933, was given broad powers to develop the Tennessee River for the presumed purpose of aiding navigation, preventing floods, reclaiming lands and, incidentally, generating, transmitting and distributing electrical energy. In carrying out this program it has already spent approximately $100,000,000 of the taxpayers' money and is proposing to spend from $200,000,000 to $800,000,000 additional. It has been truly said the Tennessee River waters four states and drains the nation.

"It seems strange that the government should spend hundreds of millions of dollars to restrict crops throughout the country while in the Tennessee Valley it spends millions of dollars to reclaim land to produce more crops.

"And it seems a little fantastic for the Tennessee Valley Authority to spend money for flood control when the citizens of Chattanooga, Tenn., the principal city on the river, are demanding of the federal government today $15,000,000 to protect their city against the floods on the Tennessee River, realizing that the Tennessee Valley Authority program will not protect them.

"The facts are that the money is not being spent for navigation or for flood control or for soil reclamation. These are but the constitutional excuses. The money is actually being spent to put the U. S. into the power business.

"T.V.A. had in its control $250,000,000 worth of property during the years 1934 and 1935 on which, according to its own annual report, it paid during the year 1935 a total of $16,900 in taxes. The property of the Tennessee Electric Power Company and the Alabama Power Company equal about the same figure, namely, $250,000,000, and in the same year they paid $4,500,000 in taxes. Or, in other words, the utility company paid 270 times as much in taxes on the same property valuation as did the T.V.A.

"What is it I am seeking? Merely this—that Congress define the limits of the operation of the T.V.A. instead of letting it go its way unhampered and uncontrolled. I proposed at the last session of Congress and I again propose:

"First—That the T.V.A. in its utility operations be required to pay taxes at the same rate and on the same basis of property valuation as the private utilities.

"Second—That it be required to keep a uniform system of accounts such as is required of the utility companies.

"Third—That it be required to charge rates for the electric energy which it sells so as to produce a fair rate of return on the value of the property which it uses in that business.

"Fourth—That before it duplicates the transmission or distribution lines of companies already in the business it be required to condemn the property thus sought to be duplicated and pay the companies owning such properties the value of the same as determined by a just tribunal.

"Fifth—That it be required to charge uniform rates to all customers of the same class and file such rates in the same manner as utilities are required to do, either with the public utility commissions of the states or the Federal Power Commission at Washington."

Industry Opinion on Highway

Highway lighting must not be left to tell its own story. Roadside signs are essential

Extracts From Letters From Power Company Presidents Discussing the Need for More and Better Highway Lighting to Prevent Traffic Fatalities — The Responsibility of the Utilities

MANY expressions of interest and purpose have come from executives of the industry in the past few months as to the responsibility of the power companies to assist in reducing the appalling toll of traffic fatalities. This was in response to an article published in ELECTRICAL WORLD on September 28 entitled "Highway Lighting—Face to Face." It presented the facts of the situation as they concern electrical men and made some definite recommendations. They were briefly:

1. That since more than 20,000 of the 36,000 fatalities that annually occur from automobile accidents happen after dark, highway lighting is definitely involved in this pressing national problem.

2. That since experiments have shown that proper highway illumination will reduce night fatalities by about 20 per cent, some 5,000 lives a year could be saved by the adequate lighting of primary highways, and the power companies have a public responsibility and a moral obligation to do something about it.

3. That since the automobile industry, the bus and truck operators and the cement and construction industries are the builders and users of the roads and have the prime interest, they should initiate action to complete the building of the highways by installing illumination for safety, just as guard rails and warning signs are provided.

4. That legislative action should be sought by these prime interests in every state to appropriate the money necessary to install and maintain adequate lighting on primary highways from gas and car license funds, now much of it diverted to unrelated purposes.

5. That the power companies should install demonstration sections of modern highway lighting outside all state capitals and important cities to educate legislators, officials and the public as to the value of good highway lighting.

6. That the power companies actively co-operate with the manufacturers in the development of highway lighting technique and equipment and work out the contractual basis on which the states and the officials should co-operate in installing and maintaining modern highway lighting.

The New Jersey Motor Vehicle Department tells a running roadside story at each demonstration section

Reprints of this article were sent to the executives of the more prominent power companies of the country, asking for an expression of their attitude and company policy and their experience in promoting highway lighting for safety within their territories. Extracts from these letters indicate the trend of the present thinking:

Indications of attitude

1. It seems to us that the division of responsibility outlined between the automobile industry and the power companies would be a basis for properly carrying forward this program of highway lighting. Whatever steps are taken by the utilities should be done in co-operation with the State Motor Association.

2. The utility industry can best co-operate with the manufacturers in the development of the most effective and efficient highway lighting units. The automobile industry, the National Safety Council, insurance companies and other kindred agencies should take the lead in creating public demand for highway lighting.

3. The utilities' part should be that of demonstration and not of pressure to secure installations. Our industry should co-operate without thought of profit, because if successful in demonstration, the widespread use of lighting for safety is bound to follow.

4. We should proceed by urging the automobile industry and related associations to grasp the importance of the activity and begin plans for creation of public interest.

5. The suggested division of responsibility is in my opinion the correct one. Both the automobile industry and the electrical manufacturers can advertise in national publications, bringing the facts to the public in a national way.

6. Utilities should see to it that the people have an opportunity to see what good highway lighting is, but I am wondering whether the entire burden should be borne by the power companies. After all, with sodium vapor lamps, the annual revenue of manufacturers is greater than the annual revenue of the power companies.

7. One of the most important things is to secure the co-operation of the State Director of Highways in any state, as it is, after all,

Lighting

through him and his organization that the recommendations for highway lighting will come.

8. State departments build the main highways in the interests of safety, pleasure and for commercial transportation and the lighting of the highways should be just as much a part of this activity as the construction of the road. Those who use the roads are expected to pay the burden. The automobile tax and the gasoline tax should be adequate for these purposes, and would be if it were not diverted for other uses.

9. We have established two separate highway demonstrations, which is the first step toward any organized highway lighting program. When this is done, interest state motor vehicle departments, safety bureaus, insurance companies, automotive associations and others, and have them press the issue from the legislative viewpoint. A special committee of the Edison Electric Institute might co-ordinate the efforts of the individual utilities.

10. Lighting installations for congested stretches of highway will give maximum results in minimizing travel hazards. Experience obtained through their operation will assist the development of high efficiency lighting units and furnish experience to determine the proper contractual relationship for more extensive applications.

11. The most important factor in initiating such a program is to have an enabling act passed. Then follow with the passage of a revenue act and establish a control board for highway lighting programs, upon which lighting interests should be represented.

As to local experience

12. Since reading your article, we have taken steps to start some highway lighting. The first job is a rather large bridge. We also want to install two sections of highway lighting of not less than a half mile, in order that the public can become acquainted with the value of highway illumination. We believe that it would be a mistake to foster this lighting ourselves without the Highway Commission taking credit for it.

13. Our engineers are getting up an estimate on the cost of equipping a 5-mile demonstration of highway lighting at a point just outside of the city, where I believe best results would be secured as a model installation.

14. A certain amount of preliminary work has been done by our company in co-operation with the State Motor Association in an attempted demonstration installation of highway lighting on one of our super highways.

15. We have just made sodium-vapor lighting installations at two important highway intersections in our territory, not only for demonstration but to obtain experience and information on operation of the equipment. We hope to follow these with further applications in co-operation with the many agencies interested in developing facts on the subject.

16. We have only today completed arrangements whereby we are going to make a sizable installation of sodium lighting for demonstration purposes.

17. Several companies under our management have been instrumental in establishing demonstration highway lighting.

18. We have practically completed arrangements to install two sections of highway for trial and study.

19. Some studies have been made and we have contacted the engineers of the Highway Commission and the officials of the automobile association. All are interested and we hope that before long a public demand for highway lighting will be created. We have selected a stretch of road for a demonstration section when details have been worked out.

20. Our company is now negotiating with the State Highway Department for a mile of highway illumination on a section which has a most unenviable reputation for frequency of accidents. If this specimen mile proves satisfactory, we believe many installations will be made throughout the state.

21. We have taken no definite steps to establish demonstration highway lighting in our territory. We are prepared to do so, however, when, and if, some definite interest is shown by the Highway Department in this activity.

As to the form of contract

22. The State Highway Department was very desirous of lighting up a new 3-mile cut-off, close to a large city, as a demonstration project and had ample funds for construction purposes, but limited funds for annual operating costs and fixed charges. The contract entered into between the state and the company provided that the company would build and own the pole line and purchase and install the constant current circuit and the fixtures for the state at cost. The company agreed to furnish the energy at a low rate and to maintain and operate the system for the state at cost.

23. The wiring system should be owned, operated and maintained by the utilities with possible ownership of fixtures by state and county agencies.

24. The form of contract would probably be different under each of the following conditions: (a) Utility has line along highway to be lighted. (b) Utility has no line along highway, but prospects of future business make it desirable if secured at not too great a cost. (c) Utility has no line along highway and sees no immediate need for such a line. The contractual basis will probably vary widely in different sections of the country for some years and changes may be necessary at various points within one company's service area.

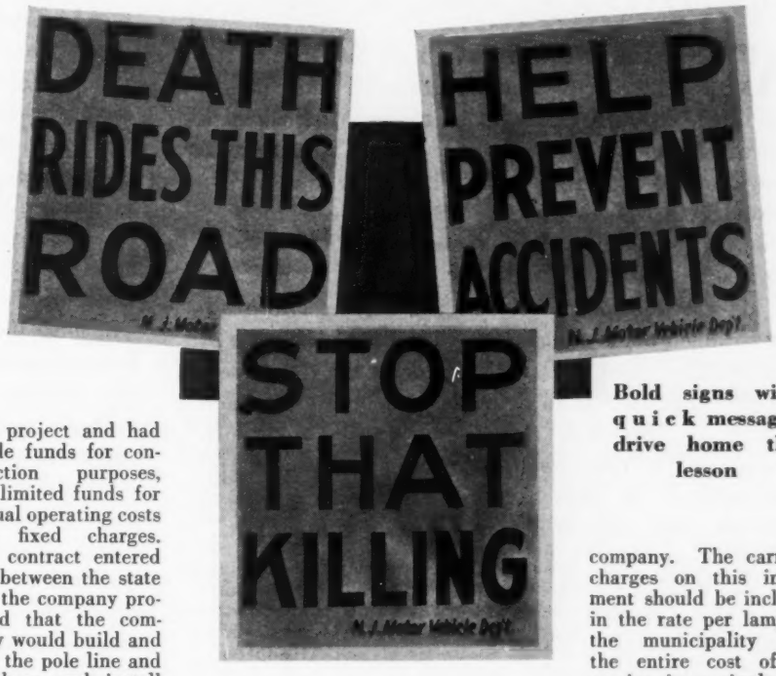
25. The same type of contractual basis should be used as is now generally used in lighting city streets. The utilities should own the equipment and furnish all necessary service under a contract with the state.

26. As a general rule, line facilities are available on main highways and no obstacles should be found to contractual conditions. In our territory we assume the cost of installation and make a flat rate per lamp per year according to size of lamp, which includes maintenance.

27. If the state or county assumed the cost of lighting a main highway, municipalities already having lighting on could divert that sum to other parts of their territory. Or a plan might be evolved in which municipalities of certain classifications would be assessed a percentage of the street lighting costs, depending on the footage basis.

28. Contract for the ultimate installation of highway lighting should call for the power companies furnishing the necessary distribution line with transforming equipment to the point of connection with the lighting system, and the state or municipal government should take the responsibility of furnishing lighting fixtures and connecting lines. Wherever possible existing poles could be used for mounting the highway lighting units.

29. We believe that the installation should be made entirely at the expense of the company and should remain the property of the company. The carrying charges on this investment should be included in the rate per lamp, so the municipality pays the entire cost of the service in a single rate per lamp per month.



Bold signs with quick messages drive home the lesson

30. I see no objection to a sound plan which would permit governmental agencies to finance a part of the construction cost and the service rates to be reduced accordingly.

Opinion naturally differs, as with any problem in which experience is limited. Some look upon it as a hopeless project at present, because of the complications besetting any dealings with legislatures and public officials. Some are pessimistic because of unhappy experience with street lighting the past few years. The majority, however, are for action and agree that the power industry has a definite responsibility to push forward the wider use of modern lighting to reduce the present appalling loss through death in the night ride.

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Taxpayers Pay $500 a Page

ADVERTISEMENTS in New York newspapers recently offering to sacrifice executive and commercial office furniture, desks, tables, chairs, filing cabinets, typewriters and "Kardexes" used by the Joint Legislative Committee to Investigate Public Utilities were a reminder that a two-year, $550,000 investigation of New York's public utility companies had, apparently, been completed.

It was just about two years ago that we were reading so much about the subversive political influence of public utility companies in New York State. A sweeping investigation was to be made without delay to confirm noisy inferential claims that utilities and politicians in New York State lolled in an unholy alliance. The mills of the gods have ground, and at a cost of $500 per page, only to inform a waiting public that:

> As a result of the most complete and exhaustive examination, your committee reports that they find no impropriety existing between any member of the state Legislature or any of the public officers and any bankers, brokers or other persons of any character or description interested directly or indirectly in public utility operating or holding companies and any public utility holding or operating companies or their affiliates or any of the officers, managers or employees of any such corporations.

This vindication could hardly be considered worth over a half million dollars. It is of interest, therefore, that the committee announced also that:

> (1) Any allegedly excess rate collections should be impounded by the state commission during litigation; (2) surplus earnings of municipal plants should not be used for general municipal purposes; (3) tax value reports and reproduction value reports should be filed with both the state's Tax Department and its commission; (4) the demand component (room count, outlets, etc.) of modern, scientifically designed rate forms should be banned; (5) copies or summaries of all electric or gas purchasing agreements should be filed with the commission; (6) capital structures and property values should be investigated under greatly broadened authority before the commission gives permission for the issuance of stocks, bonds and other securities, and other minor conclusions.

To the impartial observer the report appears to be an incongruous collection of material and immaterial subjects, and, unfortunately, is another up-to-the-minute example of those misguided attempts to substitute transient political law for the irresistible economic law. Even in these days of governmental billions, $550,000 seems to be quite a sum of money to lift from the taxpayers of a single state to refute the primary issue of alleged collusion between public service companies and public service legislators at Albany.

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Electron Jumps and Dielectric Strength

WHAT causes the breakdown of insulation? Obviously too great values of voltage stress. But what is the measure of stress that a given material can stand? All sorts of difficulties stand in the way of an experimental answer to this question. There are, for example, structural variations among various samples, internal chemical and temperature changes, as related to time, edge effect and, in general, all those factors which cause the "spread" of numerical results in a series of identical tests.

These difficulties are least troublesome in a gas. As a consequence our knowledge of the mechanism of breakdown in a gas is quite complete. In accordance with Townsend's theory a few electrons always present accelerate in an increasing field, "ionize" neutral molecules by collision, forming new electrons and positive ions, the process increasing cumulatively so as to form an avalanche leading up to breakdown. This is all right as far as it goes, but modern experimental methods permit study of the shape of the current time curve up to initial breakdown, the lowered voltage of self-sustaining breakdown, and particularly the very short time intervals involved in the several ionization stages. The result is that the simple Townsend picture does not meet the facts. Things are so rapid that the slow-moving positive ions are ruled out as chief agents, and an additional supply of primary, fast-moving electrons must be found somewhere. Such a source has now been found in the emission of new electrons from the cathode, due to radiation pulses arising from elastic collisions of electrons of earlier formation with neutral molecules.

What is an elastic collision and what is an electron jump? If a moving electron hits a molecule head on and squarely it may lose most of its energy and knock an electron out of the molecule. But even if it just misses actual collision, it may pass close enough to the molecule to cause, by an elastic impact, a serious disturbance of the electrons in the latter, and to so far "excite" them that an electron may jump from one normal orbit within the molecule to another. Such a jump is a powerful electrostatic radiator and causes a pulse of energy which, on reaching the electrodes, may be sufficient to liberate an electron. Thus, the motions and collisions of the cumulative supply of electrons in

the avalanches send back wireless messages to the cathode to liberate more, thus increasing the supply and piling up the "push" leading to the one-ten millionth of a second sparkover. By the use of this new agency A. von Hippel, in a recent review in *Exakt. Naturwissenschaften,* has offered convincing explanations of most of the peculiarities of various types of discharge in air and gases and has also extended the examination to solids.

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Behind These Appliance Merchandising Figures

ANOTHER semi-annual survey of the merchandising activities of the power companies is presented in this issue covering the full year 1935. Coming at the same time as the Edison Electric Institute's statistical report on sales of domestic appliances for the years 1931 to 1935, and following *Electrical Merchandising's* detailed statistics on ten-year sales of electrical merchandise, it provides a wealth of material for serious study.

This ELECTRICAL WORLD tabulation embraces companies serving about three-fourths of the domestic consumers of the industry. It covers about two-thirds of the market where power companies sell appliances. Several interesting facts stand out:

One—Last year water heater sales by these utility companies increased 88 per cent in number of units, range sales 65 and refrigerators 28 per cent over 1934. Increases of other appliances were far smaller, showing that the effort has been concentrated principally on the two major load builders.

Two—Power company estimates of local dealer sales are apparently quite out of line. Those utilities that estimated on the volume of the dealers in their territories reported them as selling 76 per cent of the refrigerators, 25 per cent of the ranges and 16 per cent of the water heaters that went onto the lines. But a little calculation proves that this percentage, projected for the entire country, fails to account for the output of the manufacturers. All companies have been watching these three appliances carefully and might be expected to have accurate knowledge, but they guess way low. Their estimates on other appliances show even greater discrepancy. Clearly the dealers are building more load than the utilities realize.

Three—There is an amazing difference in the success of the different companies in increasing the average annual domestic consumption and average annual appliance sales per customer. Among the many utilities that are selling household appliances in the effort to increase revenues, some gain 192, 177 and 161 kilowatt-hours per customer and others 18, 17 and 16. The reason is that some sell $55, $47 and $44 worth of appliances per customer and others $30, $29 and $28 worth. Some employed one salesperson per 472 or 531 customers and others one salesman per 9,397 and 12,708 customers. Some spent $1.81 or $1.73 per customer in advertising and some spent 12, 14 or 15 cents. Some rented the heavy load builders, some did not. Some merchandised all appliances, some just a few. Some still did not sell ranges at all.

This all gets right back, of course, to company policy. The executives of some utilities are thoroughly awake to the fact that this is not just an engineering operation with political complications, but a business of selling kilowatt-hours to customers and then giving service. These executives have hired able sales managers and given them enough money, man-power and authority to do a creditable selling job. Other companies are hobbled by old traditions and, with no less opportunity, make meager progress, because they are undermanned, spend too little money and are too conservative in policy.

One man, in sending on his figures for this tabulation, wrote: "The compiling of these data is worth more to the individual companies compiling them than it is to the industry as a whole. I have learned several things in gathering this information." It is the truth. And the wise executive will also analyze these figures, line by line, and find out how his operation stands in comparison and why.

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The Granddaddy Is Born Anew

STREET LIGHTING was the progenitor of the central-station art. Today it is undergoing a rejuvenation that makes it the readopted scion of the electric utility. The civic responsibility to render street illumination service has been transformed into an opportunity to meet public demand for safety that comes to householder, pedestrian and motorist when there is enough light to see by. The lurking hesitancy to invest in specialized facilities that could render no other function is, as it should be, giving away to a realization of a market that the traveling public is itself creating.

Press and pulpit are decrying the prevalence of sudden death and crime. Government agencies, insurance companies and others with only a public objective in view are preaching more light on the arterial highways and the busy intersections. Cities quickly dropped their parsimony on street lighting and restored the former schedules. If less was not enough, it follows that more should be better. In short, the nation is getting light-conscious and fatality-conscious.

With this asset at hand the electrical industry is remiss if it does not do its share toward attaining the logical objectives. It has at its command improved luminaires that spread the light more uniformly, minimize glare (into the windows as well as to the approaching eye) and it has the efficiencies to warrant higher intensities. It has the flexibility of the controlled multiple system, it has photronic devices to offer any schedule the city wants. If it lacks anything it is the commercial awakening to the opportunity to convert an orphan into one of its best beloved children.

Nor is this at all a matter of abandoning any of the old and well-established devices. The magnetite arc and the incandescent lamp have their proper place along with the sodium and combination mercury-vapor units. Somewhere each fits into the variety of traffic circles, boulevards, quiet streets, commercial thoroughfares, trunk highways, bridge approaches, etc., that the public is already demanding shall be lighted right.

This Game of Snooping

THERE is an old joke about the fastest way to get a piece of news traveling. The answer is: Telephone —telegraph—tell a woman. Washington is specializing on the second for the moment, and will soon be specializing on the third, all of which will probably redound to the benefit of the first. Assuming we don't get to suspecting that our telephone wires are tapped.

Meanwhile, a great many people in Washington who had no earthly connection with that flood of protests against the public utility holding company death sentence last year are on pins and needles. They know their telegrams did not concern the utility "lobby," or anything else the committee presided over by Senator Black of Alabama is supposed to be investigating. But they also know that their telegrams between February 1, 1935, and December 1 of the same year have been read by Black's investigators. And they know the possibilities which may flow from that.

The old lawyer's advice may have to be changed. He told the young blade who had just lost a thumping sum in a breach of promise suit he wanted to give him some advice.

"I know," said the young man, "do right and fear nothing."

"No," said the old lawyer. "Don't write and fear nothing."

If that lawyer were living today he might advise Washington's young blades, not to mention lawyers, lobbyists, business men and wealthy widows: "Don't telegraph either."

For it is traditional that in Washington nothing is really confidential except Supreme Court decisions prior to their delivery. And even about that one hears occasional rumors.

IT'S a perfectly human thing, as natural as eating when one is hungry and drinking when one is thirsty. The element of venality seldom tarnishes the good, clean fun of telling some one else's secrets to one's dinner partner, or one's favorite newspaper reporter. It happens all the time. Always has happened. Always will happen.

The Supreme Court of the United States, which does the best job of keeping secrets in Washington, doesn't even trust the Government Printing Office!

"But," some incredulous person might point out, "with a large force of investigators looking through a million-odd telegrams, it isn't reasonable to think they would bother with any telegrams not germane to their inquiry. The mere mass of material will protect people's secrets, just as it does in the internal revenue bureau."

Well, that last is the bunk, too, for the lawyers and experts who study the returns to see if the government should go after the taxpayers for more are human. But let's get back to these Black committee investigators.

First, how are they appointed? Naturally because they have more or less political or personal drag with some senator on the committee. Generally just with *one* senator.

Now consider young Jim Jones, loyal political supporter of Senator Squarehead, and rewarded for his activity in the senator's last campaign by this investigating job.

In the nature of things it is not a permanent job. Jim knows now that the senator appreciated his work, but after all he wants something better, something permanent anyway. Besides, there is the danger that the senator may consider his obligation to Jim discharged by this appointment.

SO WHAT does Jim do? Naturally he keeps a wide open eye for any scrap of information which might interest or amuse the senator. Or even the senator's secretary, who helped him persuade the senator that Jim deserved this appointment.

Mind you, Jim is eager for any excuse he can get just to talk to the senator's secretary, and a chance to talk to the great man himself is little short of wonderful. Now bear in mind the kind of person Jim is. He is a good mixer, and his interests are very widespread.

Dope? On the contrary, very logical. Otherwise he would not have been good enough in politics to have done the things which got him this appointment.

So he has the very kind of mind most likely to note the sort of telegram that would interest Senator Squarehead, or his secretary. Furthermore, his colleagues in the investigating squad like him, and are all playing the same game. So if one of them notes something which might interest Senator Squarehead, he calls it to Jim's attention, knowing Jim would do the same for him.

So a copy of a telegram from the senator's hated political rival making a date with a chorus girl, or trying to buy a newspaper, or offering a liberal check for a bathtub indorsement, or seeking an Ethiopian oil concession, is made. The senator's secretary thinks it's pretty hot. So does Squarehead himself.

That night at dinner Senator Squarehead has a fine tidbit for his dinner partner. Who promptly tells it to the gentleman on her left when the normal conversational about face is made along about half way through the dinner. Or he may save it for the coffee and brandy stage, never revealing, of course, how he heard it.

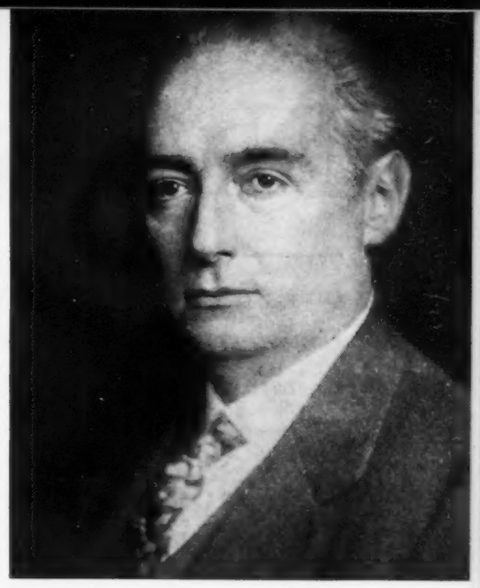
Then, too, Senator Squarehead has a favorite newspaper man. He probably represents the most important newspaper in the senator's state which does not like the senator, that being the way those things usually work out. When that correspondent drops in the senator spills the story. If it is worth while, and not libelous, somebody is pretty publicly embarrassed next day. If it's too libelous a confidential message goes to the home office, and that night the story is being told at back home dinner tables.

Absurd? That kind of thing is happening all the time in Washington.

Let's go back a few years, to avoid the present political picture.

In 1930 the Association Against the Prohibition Amendment sent a political reporter traveling around the United States. His assignment was to pick out states and congressional districts in which the wets, by spending a little money and giving other assistance, might succeed

—By CARTER FIELD



This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him.

in electing some senators and representatives who would vote to repeal the prohibition amendment. The association's money was limited, and it wanted to concentrate on the spots where its work would be most effective.

BEAR in mind that the last preceding election, 1928, had marked the high water mark of prohibition strength politically. So it looked like good politics to kick the wets around.

Then, as now, there was a lobby committee in the Senate. It was headed by Thomas J. Walsh of Montana. This committee had investigators, too. They searched the files of the association and found the confidential reports of this newspaper man. They had no relation whatever, of course, to what the committee was investigating. They discussed wet and dry sentiment in the various states and districts, strength and weaknesses of individuals suggested for wet candidates. The same with respect to dry incumbents. Who might be induced to help and why. That sort of thing.

Despite their apparent irrelevance, Senator Robinson of Indiana—since defeated—asked one day that they be put in the printed record.

Senator Blaine of Wisconsin—now dead—objected. He picked up one of the reports and read a sentence about some candidate, when asked where he stood on prohibition, raising his glass.

Action was deferred. But next day and the next the newspapers had a Roman holiday in their editorial columns. They assumed from this one sentence that the reports contained a list of the wet-drinking, dry-voting members of the House and Senate. They wanted to know why the senators were exposing everybody else, but protecting "their own."

After careful study the committee decided, quite honestly, because there was actually no such statement in the reports about any congressman, that the reports were not germane. Therefore the reports were to be kept confidential, until they should be returned to the association.

In a few days Missouri newspapers printed the Missouri report. Maryland papers printed the Maryland report, and so on all over the country. Actually it makes not the slightest bit of difference whether individual senators on the committee permitted their friends in the press to copy the reports or whether some employee of the committee did.

The important fact is that, although the committee voted to hold the reports confidential, every newspaper man who really wanted to get the report for his state could do so.

As a matter of fact, if the reports had reflected on senators and members of the House the same thing would have happened.

The Senate has never been able to do anything and keep it secret. It has almost abandoned the old "executive" sessions. Full accounts in the newspapers next day covered the "secret" discussions much more fully than those held when the doors were wide open.

So if you sent any embarrassing telegram—one that you would not like to have gossiped about at dinner parties or spread on the front pages of the newspapers—between February 1 and December 1, 1935, start hoping that your name is not prominent enough to attract the attention of the investigators. Or that it was worded so it would not sound important!

Regardless of any court action that may ensue!

MORRIS COOKE, incidentally, is now quite sure that R.E.A. can spend all the money the Norris bill will provide—fifty millions each for the first two years, and then forty millions for each of the next eight. R.E.A. has not got away to a fast start, but there is plenty on the fire now.

Utility executives might do a bit of thinking about why it is that so few private companies have borrowed this rural electrification money. And whether it is good policy. The point is that Cooke's whole inclination, believe it or not, has been to play along with the utilities. He does not have the feeling toward them that President Roosevelt has by any means. But he is being driven in that direction by the utilities themselves.

He is especially irritated, at the moment, by what his lieutenants call "spite lines." Lines hastily run through territory R.E.A. is figuring on, skimming the cream, and leaving the remainder too thin to justify development. This situation is notable in T.V.A. territory, in Georgia and in Ohio.

The drive against P.W.A. and W.P.A. loans for development of government ownership electric projects goes merrily on. Two more suits bring the total as this is written to 60. One is against the Lower Colorado River Authority (not the Grand Canyon Colorado River, but its less important Texas namesake). Proposed loan here is twenty millions of P.W.A. money. The other is against the Brazos River Conservation and Irrigation Authority. This is a proposed W.P.A. loan of thirty millions.

Contention in both cases is that government agencies by proposed loans would destroy value of property of the private companies. Also that the government agencies are forcing changes which submerge the irrigation and reclamation features of the projects and stress the power feature.

NEWS OF THE WEEK

Investigators to be investigated as result of lobby committee's telegram seizures . . . Long-term R.E.A. plan may be scrapped . . . Vandenberg assails "Quoddy" project as wasteful . . . Two Texas power districts sued . . . Housewares sales drive launched

"Quoddy" Assailed as Needless Waste

Vandenberg asserts not even P.W.A. would approve it as economical — Seven utilities go to court over loans to two Texas power districts

Whether the utilities are to be dragged into the 1936 campaign or not, their federally financed competitors are. This became a certainty this week when Michigan's Senator Arthur H. Vandenberg (also Michigan's favorite son for the Republican presidential nomination) assailed the Passamaquoddy tidal power project, declaring that the Administration had been unable to get it approved by P.W.A. or any responsible body.

"'Quoddy,'" said the Senator, "was very conclusively turned down both by the P.W.A. engineers and a board of review." But the President wanted to go ahead with it ("for what purpose we'll leave to the imagination," Mr. Vandenberg said) so he appointed a board of four, including the original sponsor and his assistant. "It was about like a bank referring an application for a loan to the applicant himself," continued the Senator.

Texas projects enjoined

In Mr. Vandenberg's opinion "Quoddy" will cost $30,000,000, against $16,000,000 for a steam plant at the same spot and with the same capacity; its power cannot be economical; there is no present or prospective market for its power, and the demand, when it comes, could be more cheaply supplied by developing Maine's unharnessed waters.

While the Administration was taking this lacing in the Senate, P.W.A. once more was being haled into the courts. (There are now 60 P.W.A. power projects in the courts; P.W.A. has allotted $76,091,446 for 269 non-federal power projects; P.W.A. has approved $151,240,481 additional for strictly federal power developments in seventeen states.)

The latest attack at law was launched by seven Texas utilities against the big program embraced in the $20,000,000 Lower Colorado River Authority and the $30,000,000 Brazos River Conservation and Reclamation District grants. Plaintiffs were Community Public Service, Dallas Power & Light, Gulf States Utilities, Houston Lighting & Power, Texas Electric Service, Texas Power & Light and Texas Utilities. They named Secretaries Ickes, Morgenthau and Dern along with a dozen or so of their right-hand men.

Their complaint, on which they have won a temporary injunction pending decision by the District of Columbia Supreme Court, goes into elaborate detail in its charges that flood control and irrigation are not the real reasons for the series of dams; that P.W.A. and its Administrator, Ickes, in Texas and elsewhere, are imposing a long list of restrictions on state power in their grants; that these grants virtually are forced on the states; that control of the projects remains in federal hands, and that definite efforts are made to regulate rates in contravention of states' rights.

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Seattle's Candidates Oppose Power Deal

Seattle's incoming city administration is not likely to be very strongly in favor of the actively discussed purchase of Puget Sound Power & Light Company's properties. Both of the mayoralty candidates who survived the primaries—Arthur B. Langlie and John F. Dore—have announced their opposition. Three of the six nominees for Alderman are known to be against the proposal.

Probers to Become Probed in Lobby Investigation

Seizure of 5,000,000 telegrams brings Senate inquiry into its committee's activities and lifts pressure which had been brought to bear on public utility companies' executives—Black enjoined

Imminent danger that the investigators might become the investigated slowed the Senate lobby inquiry down to a walk this week. Simultaneously the pressure on utility men was relaxed due to the high political odor which enveloped the Black committee after the seizing of some five million telegrams. The result was that Idaho's Republican presidential possibility, William E. Borah, won Senate approval for an investigation into the probers' maneuver.

Black puts up a fight

Democratic Senate leader Joe Robinson momentarily blocked Senator Borah's resolution calling for the inquiry, and chief prober Hugo L. Black, Alabama Democrat, put up something of a fight, but the investigation ostensibly was aimed at the Federal Communications Committee, not at the lobby committee, so it was approved without dissent. The announced purpose was to find by what authority the F.C.C. seized (Senator Black contested use of the word seizure) the wires; it asked by whom the commission had been instructed to subpœna the messages.

The storm of protest which preceded introduction of the Borah resolution was among the bitterest of those which have so far marked the early stages of the 1936 campaign. Among the most pointed attacks was that of Jouett Shouse, president of the Liberty League, who placed the blame for the telegram fiasco at the steps of the White House. The still very articulate Gen. Hugh S. Johnson rushed to the defense of the ancient prinicple of security from unlawful search and seizure. Scores of other speakers, including Representative James W. Wadsworth and Bainbridge Colby, made political capital of the situation. Senator Black, however, defended the necessity for the action and pointedly warned the courts against issuing injunctions to block Senate investigations; he implied that if the courts were to assume that they had injunctive

power which could be used to handicap such probes the judiciary might face the likelihood of having its wings clipped.

Judge Alfred A. Wheat, in District of Columbia Supreme Court, however, scorned such warnings and enjoined the committee's "fishing expeditions." He made permanent the temporary injunction granted a week ago to the Chicago law firm of Winston, Strawn & Shaw to protect their messages.

Such was the fight which all but robbed the lobby committee's actual sessions of significance and diverted public attention from them almost entirely. Thus it was that little notice was given to the fact that a mass of evidence was being introduced which had not the slightest reference to utility lobbying. Conspicuous was the testimony of one Victor A. Dorsey, who described himself as an appraiser of utility properties. Mr. Dorsey said little except to voice the opinion that write-ups in many utility organizations are such that there is no property value behind either the preferred or common stocks—that the bonds equal or exceed the physical assets.

Doherty deals under fire

Another digression came during an effort to develop the fact that Cities Service had enlisted its employees in the fight against the "death sentence." This was a side trip into high finance in which it was charged that Henry L. Doherty disposed of some $20,000,000 worth of Cities Service stock at a time when he was recommending to others its purchase and that he thereafter was able, through the expenditure of $1,000,000, to get about 25 per cent of the voting shares or working control of the system.

Court Rulings Spur Activity on Many Federal Projects

"Flood control and navigation" plans put forward by sponsors in half a dozen states — Score of Tennessee cities seek T.V.A. contracts — Fights loom in Knoxville and Chattanooga

Recent court decisions have given rise to a flurry of activity designed to launch new federal projects or to spur work on plans already under consideration. Most of these are connected with flood control and navigation, but practically all make some pretensions as power producers.

Wide publicity was given to the report of President Roosevelt's National Resources Board urging a Pacific Northwest Regional Planning Commission to link the Grand Coulee, Bonneville and Skagit projects. Less attention has been paid, however, to bills in Congress seeking flood control and power resources surveys in three states: On the San Gabriel and Los Angeles rivers and their tributaries in California, on half a dozen rivers in Kansas and on the Nueces River in Texas. Agitation also is rampant again for navigation and power development of the St. Lawrence River and engineers for the Lower Colorado River Authority soon will submit plans for the first and largest of the five dams contemplated, the $7,000,000 structure (with hydro-electric plant) near Austin. Construction already has started; the five dams involve $20,000,000.

There is $2,000,000 of P.W.A. money already available for the Fresno Dam on the Milk River project in Montana and the Bureau of Reclamation is pushing plans for a start on construction. South Carolina's P.W.A. director, J. L. M. Irby, declares that he is ready to speed work at Buzzard Roost as soon as he gets the green light from his Washington boss, Secretary Harold L. Ickes.

Significant, too, is local agitation for still another dam in the T.V.A. area. Marshall County, Tennessee, citizens want a dam across the Tennessee River 14 miles above Benton, probably at Gilbertsville (local authorities claim that site is better than those at Aurora or Shannon). And redoubled T.V.A. activity also is reflected in the announcement that there now are 750 people on the payroll in Chattanooga with a monthly salary outlay of $85,000. T.V.A. also has announced appointment of four more members of the engineering staff: Charles A. Lee, Jr., construction engineer at the Guntersville Dam; Olaf Laurgaard, general office engineer; N. W. Bowden and E. L. Chandler, to assist Sherman M. Woodward, the authority's chief water control planning engineer.

Potomac proposal spiked

But, despite all this feverish activity, there is not going to be any wild-fire appearance of "little T.V.A." projects all along the Atlantic seaboard for the time being, at least. This became clear when the President let it be known that he did not favor a Potomac Valley Authority or any other such limited project because, he said, they would be too small to be economical.

In the Tennessee Valley the Wilson Dam decision was the signal for scores of projects' sponsors to raise a hue and cry. Right off the bat T.V.A. signed contracts with four west Tennessee cities —Bolivar, Milan, Sommerville and Jackson. Mayors of Rogersville, Newport, Morristown, Kingsport, Jonesboro, Greeneville, Erwin, Elizabethton and Bristol met this week with Johnson City authorities to consider T.V.A. contracts. In Portland there was a town meeting to consider ways and means of securing T.V.A. power and the Chamber of Commerce and Mayor Martin have joined hands in a similar move. Neighboring Alabama towns—Sheffield, Florence and Tuscumbia—want contracts, as do North Little Rock, Ark., and Columbus, Miss. And bills have been passed in Kentucky to permit municipal ownership of power

A HORNET'S NEST IN OLD TELEGRAMS

Acme

Here is Senator Hugo L. Black, peppery Alabama Democrat and chief lobby prober, holding up some of the controversial wires which his committee subpœnaed in an action which aroused a storm of "illegal search-and-seizure" protest. Pictured with Senator Black (left) at the hearing are colleagues Sherman Minton, Indiana (center) and Lewis B. Schwellenbach, Washington (right).

plants and to allow their connection with T.V.A. lines.

These developments, however, were less spectacular than the bitter battles which have been revived in three of Tennessee's larger cities—Knoxville, Chattanooga and Memphis. In Knoxville, served by Tennessee Public Service (Bond & Share), the city is seeking in the State Supreme Court to have the injunction against its proposed municipal plant lifted so that it may sign new contracts with P.W.A. and T.V.A. And the Pittsburgh contractors retained for the job, Hess & Barton, have asked that the case be remanded to the lower courts and tried on its merits.

The city of Memphis has signed a 20-year contract for T.V.A. power, announcing that it is ready to build its own municipal distribution system with a $9,000,000 bond issue if necessary. In the meantime, it continues to negotiate with Memphis Power & Light (Bond & Share) on the latter's offer to supply T.V.A. power to customers in the city by means of its present distribution system and the belief is that this plan may be ironed out if rates can be agreed upon. Meanwhile, W. J. Hayes, T.V.A.'s regional co-ordinator, has announced that the authority is ready to build a transmission line to Memphis.

Chattanooga is threatening to go ahead at once with the sale of $8,000,000 of bonds to build its own distribution system. This announcement followed days of wrangling with officials of Tennessee Electric Power (Commonwealth & Southern) for the purchase of the latter's distribution facilities with the top price presumably $8,000,000. This was flatly turned down by Tennessee Electric's president, Jo Conn Guild. City authorities declared there was no course left open but to build a competing system.

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Three Utilities Sued for $12,500,000 Each

The utility companies which have delayed construction of the Santee-Cooper project have grievously damaged the South Carolina Public Service Authority, according to its counterclaims filed in reply to amended answers entered by the power companies in federal District Court in Charleston. In fact, the authority has been so seriously damaged by the suits which have held up allocation of the $37,500,000 fund that it asks $12,500,000 damages from each of the three utilities, South Carolina Power, Broad River Power and Carolina Power & Light.

The plaintiff firms are accused of "willfully and maliciously" conspiring to prevent construction.

Ontario Signs New Contracts

Gets cut of $2.50 per horsepower from Gatineau and Maclaren — Beauharnois and Ottawa Valley companies, which are suing, are left out of deal

Ontario's Hydro-Electric Power Commission has finally concluded new power contracts with two private companies to write finis on that phase of the 1935 cancellations; the case now is up to the courts, where Ottawa Valley Power and Beauharnois Power are seeking to have the cancellation declared illegal.

Under the new contracts the commission is to purchase from Gatineau Power and Maclaren-Quebec Power at a basic rate of $12.50 per horsepower against $15 in the old contracts; the amount of power to be purchased is sharply curtailed; the companies which have filed suits get no new contracts. Attorney-General Arthur W. Roebuck asserts that the province will save $29,472,689 in the four years from 1936 to 1939, inclusive, promises lower rates in eastern Ontario in the immediate future, and forecasts a "back to Niagara" movement in the Hydro Commission's effort to build up an adequate power supply.

Thus Mr. Roebuck, in a six-hour speech before the provincial parliament, classed the matter as a closed chapter in Ontario's history; not so the two companies which are suing. These companies are joined in the attack by financial houses which are interested in their bonds and contend that the province exceeded its powers in passing the law under which the contracts were cancelled. Payments are asked for the late months of 1935 and the courts are urged to protect the rights of the bondholders whose money, in good faith, went into the expansion program made necessary before the contracts were cancelled.

Dominion keeps hands off

Another phase of the litigation, however, seems predestined to failure. This is the effort to get the Dominion government to step in and declare that the Ontario parliament overstepped itself in the cancellation. In official circles it is reliably reported that the Dominion's justice department will keep hands off, as predicted in ELECTRICAL WORLD (February 8, page 4).

The Current Drift

City Plant "Cuts Itself In"

Cleveland's municipal power plant may or may not have the surplus capacity to supply any great part of the energy for illuminating Great Lakes Exposition buildings and grounds, but the city fathers couldn't see Cleveland Electric Illuminating Company getting an exclusive contract. Despite the fact that the exposition lighting load will come at night when the demands on the city-owned plant are heaviest, the Council insisted that the contract with exposition authorities be altered to allow the city to furnish whatever power it has available.

Those Self-Liquidating Lines

Critics of the co-operative rural electric line have been doubtful about projects paying for themselves, but down in North Carolina they have figured out how they can repay their loans in 5.67 years. Here is the idea, as set forth by C. W. Burton, assistant director of the state rural electrification authority:

There have been 1,011 rural lines of 6,001.59 miles surveyed by the authority. For their construction a federal R.E.A. loan of $6,001,590 would be needed. Now, on these lines there would be 32,058 customers and the annual revenue would be $1,058,572, enough to pay the loan in 5.67 years. Q.E.D.

Attention might be called to some omissions in Mr. Burton's accounting: Cost of generating or purchasing the electrical energy, cost of distribution, depreciation, maintenance and repairs, collections, etc.

Lesson in Public Ownership

Advocates of municipal ownership of power facilities in Milwaukee have some interesting questions to laugh off when opponents cite the experience of the city water department. To start with, residential water rates are now 61 per cent higher than in 1914, while domestic electric rates are 58 per cent lower.

The reasons for the rise in water rates, however, are even more remarkable. It seems that there was an increase from 4½ cents per hundred cubic feet to 7 cents, plus a $2 annual service charge, back in 1921. That was to cover the cost of building a filtration plant. Despite a subsequent cut to 6 cents, the service charge remains in effect and customers have paid an estimated $13,000,000 in increased rates in the meantime. That wouldn't be quite so bad if the filtration plant had been paid for, but, when the city needed $5,000,000 for such payments, it was discovered the money had been diverted to other uses!

On top of all this, property owners have contributed about $5,000,000 through water main assessments and have invested $4,500,000 for service pipes and meters.

Long-Term R.E.A. May Be Scrapped

Administration leaders would drop bill to speed "must" program — Niagara Hudson to build 2,000 miles of rural line to serve 7,000 farms this year

The Senate has passed the modified Norris bill for a long-term R.E.A., but the rumor persists that this and other controversial measures will be sidetracked by Administration leaders in Congress to clear the way for the tax, appropriation and relief bills. Thus Nebraska's Senator George W. Norris, No. 1 public power man in Congress, may have compromised in vain in getting the bill through the upper house. He agreed to a cut from $100,000,000 a year for ten years to $50,000,000 a year for two years and $40,000,000 annually thereafter, a total of $420,000,000 instead of a billion.

Another interesting change was that the $50,000,000 a year for the first two years would be borrowed from the R.F.C. so that they would not show up as budget items in these hectic days of window dressing for voters who may be demanding economy in government by next November. With this dolling up the bill passed the Senate without a record vote, but Administration leaders admit, off the record, that it is far from out of the woods.

While this problem involves Congress, the question of service for the farm still absorbs private companies and the R.E.A.-financed co-operatives. R.E.A. so far has authorized projects totaling $8,144,862 to serve about 27,000 customers on 7,500 miles of line. An interesting contrast to these figures is provided by the program of a single private system, Niagara Hudson, which now has 10,073 miles of rural line with 28,634 customers and plans the addition of about 2,000 miles to serve 7,000 more farms this year. This program, it is assumed, would mean an outlay in the neighborhood of $2,500,000. Last year Niagara Hudson built 452 miles of new rural electric distribution lines to serve 1,856 customers.

Additional data on the rural electrification problem are provided by the Edison Electric Institute, which notes that power was provided for 44,840 farms in 1935, bringing the total served to 788,795, or 12½ per cent of all classes of farms in the United States. It is pointed out, moreover, that of the 6,288,000 farms listed by the Bureau of the Census about 400,000 have no houses on them at all and 2,516,000 more have dwellings valued at less than $500.

"Since it costs $350 for wiring and for the more common appliances in the home, few of these farms are prospective electric customers," the review continues. This survey lists the percentage of farms with dwellings valued at $500 or over which are served at 20.9 per cent at the end of last year.

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S.E.C. Prepares Rules for Holding Companies

Holding companies which registered under the Public Utility Act of 1935 shortly will have a better idea of what is expected of them for the Securities and Exchange Commission has prepared a proposed set of rules covering service, sales and other contracts with subsidiaries.

Copies have been sent to registered companies, the National Association of Railroad and Utilities Commissioners, the Committee of Utility Executives and the Federal Power Commission for criticism and suggestions.

President Lowers Norris Dam Gates

Presses key to give apparently innocent signal, but act paves way for T.V.A. test — Willkie says navigation is only a thin excuse for this paradoxical program

The touch of President Roosevelt's hand to a golden telegraph key was, on the face of it, the signal for lowering of sluice gates to start water storage at Norris Dam. But the broader significance was the completion of the huge concrete dam—1,872 ft. long, 265 ft. high and 204 ft. thick at the base—and the launching of a 132,000-hp. generating project which will probably shortly provide the legal test upon which will hang the fate of the gigantic Tennessee Valley Authority program and the Administration's power plans.

There is no navigation lock at Norris Dam for the Clinch River is not navigable. But early next fall—perhaps in August—the lake will have attained nearly enough to its 3,400,000 acre-ft. capacity to begin generation of electricity. Then it is expected that the $35,000,000 dam will be the center of the court test to determine whether T.V.A. actually is a navigation-flood control-soil conservation project or whether it really is to generate energy in competition with private business and provide a "yardstick"—to determine, if the purpose is power, whether the government can, under the Constitution, undertake such a development.

Some of the public utility industry's probable contentions in this test were indicated by Commonwealth & Southern's Wendell L. Willkie just after the President officially acknowledged the completion of Norris Dam. In a radio address which bristled with opposition to

Additional Projects Approved by R.E.A.

Borrower	Miles of Line	Farms Served	Amount of Loan	Source of Power	Rate*	Territory
Logan County Co-operative Pr. & Lt. Association, Bellefontaine, Ohio.	215	860	$225,000	Municipal	$5.70	Logan County, Ohio
Florida Power Corp., St. Petersburg, Fla	184.6	455	164,500	Own stations	6.10	Northern and western Florida
Georgia Pr. & Lt. Co., Valdosta, Ga.	99.1	663	109,200	Own stations	4.83	Eleven Georgia counties
Farmers Rural Utilities, Inc., Bowling Green, Va.	406	1,511	366,800	Va. El. & Pr. Co.	4.80	Four Virginia counties
Farm Electric Service Co., Aitkin, Minn.	100	300	100,000	Minn. Pr. & Lt.	6.45	Aitkin County, Minn.
Lorain-Medina Rural Electric Co-operative, Wellington, Ohio.	168	654	232,700	Municipal	4.95	Lorain and Medina counties
Rayle Electric Association, Rayle, Ga.	11.2	53	12,000	Municipal	5.00	Wilkes County, Ga.
Champaign County Rural Electric Co-operative, Columbus, Ohio.	440	1,925	595,000	Municipal	4.95	Champaign County, Ohio
R E.A. Allocations Subject to Revisions						
Crisp County Farmers' Co-operative Corp., Cordele, Ga.	84	....	85,000	Public	....	Crisp County, Ga.
Bluffton (Ind.) Municipal Light & Water Works	15	81	17,100	Municipal	....	Wells County, Ind.
Scott County Rural Electric Co-operative, Davenport, Iowa	265	900	260,000	Private	....	Scott County, Iowa
Meeker Co-operative Lt. & Pr. Assn., Litchfield, Minn.	420	1,300	450,000	Municipal	....	Meeker County, Minn.
Lancaster County Public Power District, Lincoln, Neb.	354	900	396,000	Public	....	Lancaster County, Neb.
Tide Water Power Co., Wilmington, N. C.	128	1,000	142,500	Own stations	....	Eastern North Carolina
Northwest Rural Electric Co., Minneapolis, Minn.	115.2	....	146,000	Mont.-Dak. Pr. Co.	....	Northwestern North Dakota
Plymouth Electric Light Co., Plymouth, Vt.	20	73	19,000	Cent. Vt. P. S.	....	Vicinity of Plymouth, Vt.
Clarke-Washington County Power Association, Birmingham, Ala.	58.4	267	65,000	Ala. Power Co.	....	Clarke & Washington counties, Ala.
Lee County Power Association, Inc., Opelika, Ala.	73.9	227	72,000	Municipal	....	Lee County, Ala.
City of Hawarden, Iowa.	150	300	127,500	Municipal	....	Sioux County, Iowa
City of Gowrie, Iowa.	26	74	26,000	Municipal	....	Webster County, Iowa
Boone Valley Electric Co-operative, Renwick, Iowa.	40	118	45,000	Municipal	....	Wright County, Iowa
Corning Municipal Utilities Co., Corning, Iowa.	110	355	120,000	Municipal	....	Adams County, Iowa
McLeod Co operative Power Assn., Glencoe, Minn.	636	....	650,000	.....	....	Six Counties in Minn.
Belfalls Lt. & Pr. Co., Temple, Tex.	300	870	452,000	Diesel plant	....	Bell, Falls, Milan counties, Tex.
East Texas Utility Corp., Tyler, Tex.	254	1,460	214,000	So'west G. & E.	....	Ten counties in eastern Texas

*Rate subject to later revision.

government in business and dwelt on the paradoxical nature of the T.V.A., Mr. Willkie declared the authority to be "the most useless and unnecessary of all the alphabetical joy rides."

The speaker further asserted that $100,000,000 has already been spent and the total cost may ultimately run into $800,000,000; that T.V.A. would be of no material value to the Tennessee valley; that it is nothing but an encroachment on private business; that it has ignored all chances to recover on the investment. Further, he said, T.V.A. purports to develop the navigation of the Tennessee River when the area already has a rail and road system which is more than adequate; it throws millions of dollars into improving farming lands in the area when other millions are being poured into crop reduction elsewhere in the nation. He flatly declared navigation to be only a constitutional excuse to allow the government to go into the power business. He demanded, therefore, that T.V.A. meet the same taxes, expenses and regulations as are imposed upon the private companies before undertaking to set up a yardstick for private companies' rates.

In the meantime, all hands are wondering where the next test of T.V.A.'s constitutionality will be launched. It could come in the Knoxville mix-up, where Tennessee Public Service has asked an injunction to prevent the city borrowing $2,600,000 from the P.W.A. to construct its own distribution system. This, of course, is a suit leveled at P.W.A., but T.V.A. is a party to the contract. The utility says it has $4,000,000 invested in Knoxville and that the contract threatens to wipe out this property.

There also is the chance that government construction of a substation to cost $200,000 at Jackson, Tenn., might be challenged. This project has been announced by Earle R. Wall, T.V.A. projects engineer, but the site has not definitely been determined, so that the station so far scarcely lends itself to the prospective court test.

•

Uniform Accounts Get Court Test

Arguments were presented last week in the New York Public Service Commission's effort to enforce a revised system of accounts for electric utilities, emphasizing the segregation of capital accounts so as to show original cost, to set up straight-line depreciation, and to charge against surplus the price paid for properties over and above their original cost.

Meanwhile the National Association of Railroad and Utilities Commissioners met in Washington and heard representatives of the electric industry criticise the rules of uniform accounting practice which the association is preparing to advocate before the Federal Power Commission. As the commissioners' accounting committee has not yet cleared up all points, another delay has been encountered in submitting recommendations to members.

•

Engineering Council Regroups Committees

Regrouping of committees to simplify the understanding of major objectives is announced by the American Engineering Council. The set-up calls for four major committees: (1) The committee on public affairs; (2) the committee on engineering-economics; (3) the committee on programs for united action of member organizations, and (4) the American Engineering Council operating committees.

Other committees have been made subsidiary to these four top groups, while the general chairmen of the major committees have been made members of the council executive committee.

COMING MEETINGS

Edison Electric Institute—Third annual sales conference and sales committee meetings, Edgewater Beach Hotel, Chicago, Ill., March 23-27. Annual convention, Municipal Auditorium, St. Louis, Mo., June 1-4. Bernard F. Weadock, managing director, 420 Lexington Avenue, New York, N. Y.

Florida Engineering Society—Annual meeting Daytona Beach, Fla., April 2-4. W. W. Fineren, secretary, University of Florida, Gainesville.

Midwest Power Engineering Conference—Chicago, Ill., April 20-24. G. E. Pfisterer, secretary, 308 West Washington Street, Chicago, Ill.

Association of Iron and Steel Electrical Engineers—Spring engineering conference, Youngstown, Ohio, April 22-23. Brent Wiley, managing director, Empire Building, Pittsburgh, Pa.

Electrochemical Society—Spring meeting, Cincinnati, Ohio, April 23-25. Colin G. Fink, secretary, Columbia University, New York, N. Y.

Missouri Association of Public Utilities—Annual meeting, St. Louis, Mo., April 29-May 1. Jesse Blythe, assistant secretary, Merchants Bank Building, 101 West High Street, Jefferson City, Mo.

Southeastern Electric Exchange—Annual conference, Fort Sumter Hotel, Charleston, S. C., April 30-May 1. J. W. Talley, executive secretary, 308 Haas-Howell Building, Atlanta, Ga.

National Electrical Wholesalers Association—Annual convention. The Homestead, Hot Springs, Va., May 4-9. E. Donald Tolles, managing director, 165 Broadway, New York.

American Institute of Electrical Engineers—North Eastern District meeting, New Haven, Conn., May 6-8; summer convention, Huntington Hotel, Pasadena, Calif., June 22-26. H. H. Henline, national secretary, 33 West 39th Street, New York.

National Electrical Manufacturers Association—Spring meeting, The Homestead, Hot Springs, Va., May 17-21. W. J. Donald, managing director, 155 East 44th Street, New York.

Administration Hit for Competition

The federal government is taking money from the utilities and other industries to finance competitors and the power companies must realize the necessity for electing God-fearing and intelligent men to represent them in Congress, the business development section of the Northwest Electric Light and Power Association was told as it opened its annual meeting in Spokane, Wash. The speaker was Frank T. Post, president of Washington Water Power, who delivered the address of welcome to the 250 delegates.

Among the featured talks at the sessions were the following: "The National Kitchen Modernizing Bureau," by Dr. G. W. Allison of the Edison Electric Institute; "Developments in Dealer Relations," by William A. Cyr, associate editor of *Electrical West*, and "Water Heating from the National Viewpoint," by A. H. Jaeger, manager of the water heater division of the Edison General Electric Appliance Company, Chicago.

W. C. Mainwaring, British Columbia Electric Railway, was convention chairman, with George Wisting of the Northwestern Electric Company as vice-chairman.

•

Three Associations Plan Luncheon for Comstock

A luncheon next Thursday, March 19, will be tendered Louis K. Comstock, head of the Merchants Association of New York, by the merchants' group, the New York Building Congress and the tenth anniversary committee of the American Arbitration Association.

The meeting is one of a series which will feature leading industries using arbitration. The New York Building Congress was a pioneer in this field, with Mr. Comstock as chairman of its arbitration committee since its inception.

•

Engineers Organize

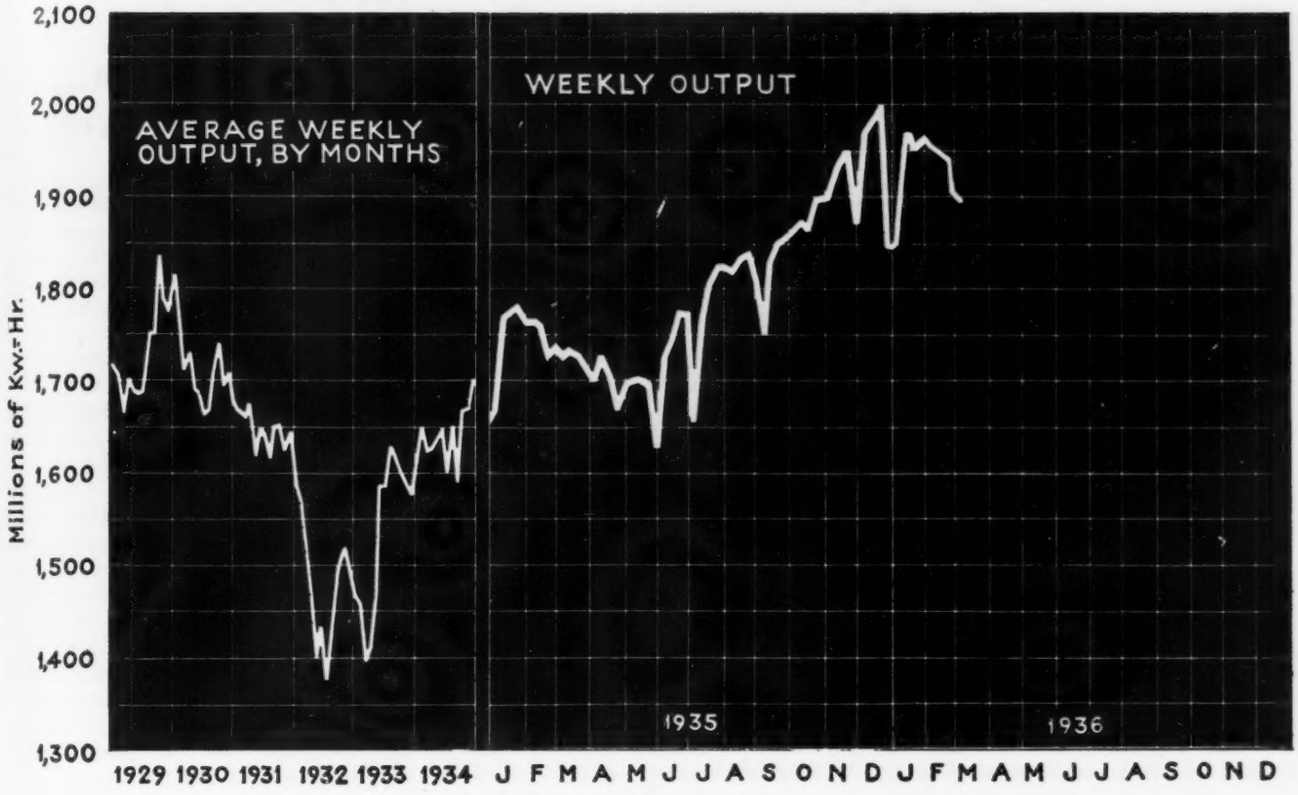
Organization of the Electrical Maintenance Engineers Association of Southern California has been completed with the election of W. E. Coburn, Los Angeles Board of Education, president; C. M. Hoag, Union Oil Company, vice-president, and C. F. Kimball, Ford Motor Company, secretary-treasurer.

•

Power Exports Approved

Electric energy exports by twenty companies in the United States were approved last week by the Federal Power Commission. Thirteen of the companies export to Mexico and seven to Canada.

Output Decreases as Days Lengthen



Still running approximately parallel with 1930 and 1935, but nearly 10 per cent higher than in the latter year, the curve of energy production in electric light and power plants declined moderately in the week ended March 7 to 1,893,311,000 kw.-hr., according to the Edison Electric Institute. As is usual at this time of the year the trend during recent weeks has been definitely downward but the total decrease since the middle of January has been no greater than it was last year and it has been somewhat smaller than in 1930, when previous records were established. Compared with that year the present production shows a gain of 8.2 per cent.

It should not be inferred that this indicates a corresponding increase in industrial activity. Considerably more energy is being used for domestic purposes now than six years ago and there has been some increase in retail commercial sales. Nor has there been anything like an equivalent increase in revenue, as is evident from the monthly statistics on this point.

Regional gains over 1935 range from 6.6 to 14.6 per cent.

Per Cent Change from Previous Year

Region	Week ended Mar. 7	Feb. 29	Feb. 22
New England	+ 6.6	+ 8.1	+ 8.3
Middle Atlantic	+11.3	+10.3	+12.5
Central Industrial	+ 9.4	+ 8.8	+10.8
West Central	+13.5	+14.9	+14.9
Southern States	+10.4	+10.2	+12.2
Rocky Mountain	+14.6	+19.5	+24.0
Pacific Coast	+ 8.9	+11.4	+15.8
United States	+ 9.8	+ 9.7	+12.3

Weekly Output, Millions of Kw.-Hr.

1936		1935		1934	
Mar. 7	1,893	Mar. 9	1,724	Mar. 10	1,647
Feb. 29	1,903	Mar. 2	1,734	Mar. 3	1,658
Feb. 22	1,942	Feb. 23	1,728	Feb. 24	1,646
Feb. 15	1,950	Feb. 16	1,761	Feb. 17	1,641
Feb. 8	1,952	Feb. 9	1,764	Feb. 10	1,652
Feb. 1	1,963	Feb. 2	1,763	Feb. 3	1,636

Highest Month Ever Recorded

January production of electrical energy for public use started the year with the largest average daily and monthly production ever recorded in the United States. The month's output, as announced by the U. S. Geological Survey, was 9,131,285,000 kw.-hr., 11 per cent larger than in January, 1935, and about 1½ per cent larger than in December. The latter is about twice the normal change from December to January. Water power contributed 3,400,213,000 kw.-hr., or 37 per cent of the total—the same fraction as in December. Energy produced from fuels was 5,856,900,000 kw.-hr.

The quantities reported by the Geological Survey are not restricted to central stations for light and power, but are based on the operations of all power plants producing 10,000 kw.-hr. or more per month, generating energy for public use. This includes electric traction, public works, Bureau of Reclamation and others. The output of plants which fail to report is estimated.

Gains Over Previous Year, per Cent

	Sept.	Oct.	Nov.	Dec.	Jan.
United States	+14	+13	+14	+13	+11
New England	+16	+14	+10	+ 9	+ 3
Middle Atlantic	+ 9	+ 8	+10	+11	+ 8
E. No. Central	+14	+18	+18	+18	+11
W. No. Central	+16	+11	+19	+ 4	+ 4
South Atlantic	+25	+19	+23	+16	+19
E. So. Central	+13	0	+ 1	+16	+ 9
W. So. Central	+ 8	+ 9	+12	+14	+10
Mountain	+40	+22	+15	+14	+19
Pacific	+11	+12	+14	+14	+15

Interconnection to Remain

When blizzards downed 18 miles of West Kootenay Power's lines in Okanagan Valley, the company hooked onto the West Canadian Hydro-Electric Corporation's system. Now the two companies have decided to make the interconnection permanent.

•

Power Dam Authorized

Authority for construction of another new dam—a $3,000,000, 26,000-hp. hydro-electric power project on the Kanawha River in West Virginia—has been granted to the Kanawha Valley Power Company by the Federal Power Commission. The license permits construction, beginning May 1, 36 miles below the recently completed Marmet Dam.

Light and Power Stocks Decline

In a market that reflected the tense situation in Europe, elctric light and power stocks lost some ground this week. "Electrical World" index, 35.6; last week, 36.2.

Associated Upheld on Investing Plan

New York state's attack on Associated Gas & Electric's Employees Investing and Welfare Plan was scrapped in Supreme Court when Justice John McGeehan refused to give the Attorney-General an injunction. The court declared that employees who purchased bonds under this plan are getting 8 per cent interest, that the security for the bonds is apparently ample, and that the state failed to show any fraudulent practice.

The Attorney-General's office had declared the Investing and Welfare Plan amounted to a system for forcing employees to take part of their pay in bonds and alleged that third parties, acting for Associated Gas, had repurchased the bonds below par. Injunctions had been sought to end the sale of securities to employees and to bar repurchases below par, temporary writs having been issued on both points by Justice McGeehan a fortnight earlier (ELECTRICAL WORLD, February 15, page 44.)

•

Stockholder Would Oust New England Gas Heads

"Financial juggling and chicanery" are charged and an accounting asked by John J. Powers of Braintree, Mass., a preferred-stock holder, in a suit asking the ousting of Howard C. Hopson and other trustees of the New England Gas & Electric Association. The suit, filed in Probate Court in Dedham, Mass., names fourteen past and present officers of the company.

Mr. Hopson is not listed in statistical records as a trustee and the company, saying he has not been on the board for some time, charges that his name was mentioned by the plaintiff for publicity purposes.

•

Cities Service Units in Ohio Would Merge

Approval of the Ohio Public Utilities Commission has been asked for purchase of the Lake Shore Power Company by the Toledo Edison Company. Both are affiliates of Cities Service Power & Light. Toledo Edison proposes to assume Lake Shore's $1,005,000 of first and refunding series A 6s and to issue $963,338 of 5 per cent notes.

•

Many Big Issues Ready for Market

Public utility financing continues largely in the pending stage, but the most interesting fact is that the issues immediately overhanging the market are in the biggest volume since last November, when borrowers were breaking their necks to get in under the December 1 deadline set up in the Public Utility Act of 1935.

The largest issue is the $90,000,000 Pacific Gas & Electric registration with the S.E.C. The company plans to refund $34,975,000 of first and refunding series E 4½s, due 1957; $49,610,000 first and refunding series F 4½s, due 1960, and $3,694,000 refunding and consolidated 5s, due 1948, of the Northern California Power Company.

Consolidated Gas of New York has asked the Public Service Commission for approval of $70,000,000 of debentures to bear interest at 3¼ and 3½ per cent to refund $50,000,000 of debenture 5½s, due 1945, and $20,000,000 of debenture 5s, due 1957.

Also pending are $75,000,000 Eastern Gas & Fuel Associates bonds; $56,000,000 of Consumers Power refunding; a $13,500,000 California Oregon Power refunding issue, and two issues for Iowa Electric Light & Power, $3,600,000 of first mortgage series E 4s and $1,250,000 of 3 per cent coupon notes maturing from 1936 to 1941.

Current Earnings Reports

Operating Companies

	1935	1934
Commonwealth Edison (Year ended Dec. 31)		
Gross earnings	$79,148,801	$75,929,638
Net balance	3,841,274	3,805,447
Louisville Gas & Elec. (Year ended Dec. 31)		
Gross earnings	10,392,170	10,023,927
Net balance	1,479,182	1,474,497
Potomac Elec. Pwr. (Year ended Dec. 31)		
Gross earnings	13,154,881	12,127,511
Net balance	3,611,126	3,203,750
Public Serv. of No. Ill. (Year ended Dec. 31)		
Gross earnings	36,351,025	34,999,928
Net balance	2,332,992	2,251,762
Conn. Lt. & Pwr. (Year ended Dec. 31)		
Gross earnings	17,872,783	16,943,112
Net balance	3,690,240	3,675,556

	1936	1935
Alabama Power (Year to Jan. 31)		
Gross earnings	$16,961,085	$15,458,466
Net balance	705,654	437,050
Consumers Pwr. (Year ended Jan. 31)		
Gross earnings	30,755,466	28,836,997
Net balance	3,893,380	3,027,472
Detroit Edison (Year ended Jan. 31)		
Gross earnings	50,139,513	45,512,066
Net balance	10,024,458	5,474,670
Georgia Pwr. (Year ended Jan. 31)		
Gross earnings	23,860,958	22,197,119
Net balance	1,576,414	1,015,204
Ohio Edison (Year ended Jan. 31)		
Gross earnings	16,002,775	15,363,713
Net balance	1,595,903	1,448,271
Tenn. Elec. Pwr. (Year ended Jan. 31)		
Gross earnings	13,482,356	12,459,431
Net balance	515,365	329,376

Holding Companies

	1935	1934
Columbia Gas & Elec. & subs. (Year ended Dec. 31)		
Gross earnings	$81,453,525	$77,706,925
Net balance	5,006,183	2,940,707
Northern States Pwr. & subs. (Year ended Dec. 31)		
Gross earnings	33,008,516	32,171,056
Net balance	288,771	106,755

	1936	1935
Commonwealth & Southern & subs. (Year ended Jan. 31)		
Gross earnings	$123,023,226	$115,692,294
Net balance	536,559	1,386,299*
Pub. Serv. Corp. of N. J. & subs. (Year ended Jan. 31)		
Gross earnings	119,091,562	120,430,504
Net balance	23,505,877†	25,018,446†

*Deficit. †Available for all dividends.

Gross earnings—(Operating Companies) Gross operating revenue. (Holding Companies) Gross operating revenue plus other income. Net balance—Balance available from income for common stock dividends.

MANUFACTURING AND MARKETS

Sales Campaign for Housewares

E.E.I. and N.E.M.A. announce broader plans for 1936, starting with "Electrical Housekeeping Week" in April

Spurred by the success of last year's electrical housewares sales campaign, the Edison Electric Institute and the National Electrical Manufacturers Association have announced a much broader program for 1936. The start will be made in April, which has been designated as "Electrical Housekeeping Month," when appliances such as irons, clocks, table mixers, percolators, etc., will be pushed.

Other special events include the June "Electrical Wedding Month," October as "Buffet Serving Month" and December with another "Electrical Housewares Week" along the lines of that in 1935 which is estimated to have added 10 per cent to the month's business. Backing up the efforts of these various campaigns will be the publication of "Electrical Housewares" as in the past. Local cooperation throughout the branches of the industry involved is being organized, sales promotion material is being developed for each of the "weeks" or "months," including window displays, sample advertisements and contest ideas. Trade paper publicity is planned to announce and support the program.

The electric housewares program will closely parallel the kitchen modernizing activity of N.E.M.A. and E.E.I. members, which is now thoroughly organized and officially launched. Thousands of copies of the plan book, a large, sixteen-page publication with complete details of promotion and organization plans, instructions for local programs and supplemental displays and advertising hints, have been distributed through the executive committee headed by George E. Whitwell of Philadelphia Electric, national chairman, and Harold F. Smiddy, vice-chairman.

These housewares and kitchen campaigns are landmarks along the trail of the broader program which all concerned hope to set up through the new Electrical Industry Promotion Committee (ELECTRICAL WORLD, March 7, page 9) which embraces the contractors' and wholesalers' associations as well as E.E.I. and N.E.M.A. Ultimately it is planned to include complete programs for housewares, kitchens, better lighting, adequate wiring, street and highway lighting, air conditioning and electric welding.

•

Square D Pays Extra, Votes to Split Stock

Directors of the Square D Company last week declared the first dividend in five years on the class B stock—25 cents a share quarterly and 10 cents extra—and approved a three for one split of the issue. Gen. Otto H. Falk, Allis-Chalmers chairman, and Fred B. Lewis, vice-president and general manager of Southern California Edison, were added to the board.

•

Bulb-Frosting Patent Upheld in Circuit Court

The General Electric Company has been upheld in its patent covering the interior frosting of electric light bulbs in the federal Circuit Court of Appeals in Cincinnati, the decision reversing the District Court. Infringement was charged to the Save Sales Company of Toledo. The court ruled General Electric's claims valid, granted injunctive relief and ordered an accounting.

•

Electric Refrigerator Sales Up for January

Electric refrigerator sales in the United States in January totaled 108,985 units with a value of $8,523,114, compared with 82,103 units valued at $7,175,059 in the first month of 1935, the National Electrical Manufacturers Association reports.

N.E.M.A.'s figures show 415 units worth $34,099 sold in Canada in January, while other foreign business totaled 7,186 units valued at $519,693.

•

Air-Conditioning Record Established in Chicago

All air-conditioning tonnage records for February were broken in Chicago last month with 22 new installations, 1,248 hp. and 1,472 tons of refrigeration, compared with 21 installations, 1,050 hp. and 851 tons of refrigeration in the corresponding 1935 month, according to figures compiled by the Commonwealth Edison Company.

HALF A MILLION TO SEE BETTER SIGHT FILM

General Electric

A three-reel sound-on-film motion picture, "Light for Living," this year will be seen by half a million people and the message carried to other millions by word of mouth. This "still" was made during the filming in General Electric's Nela Park, Cleveland, incandescent lamp department. The film is available in both 16 and 35 mm. sizes and is being shown in many foreign countries as well as throughout the United States.

G. E., Sangamo Raise Dividends

The weight of dividend increases by important companies during the last few days has taken its place beside improved earnings statements to emphasize the extent of the electrical manufacturing line's recovery. Taking the lead was General Electric with a financial statement for 1935 showing sales billed of $208,733,000, a gain of $43,936,000 or 27 per cent over 1934; net of $27,843,000, or 97 cents a common share, against $19,726,044, or 59 cents a share, in 1934; a 25-cent quarterly dividend on the common stock, compared with 20 cents each in the two preceding quarters and with 15 cents early last year.

Westinghouse, which earlier had announced earnings estimates of more than $4 a share, this week reported the largest net since 1929 at $11,983,380, equal to $4.49 a share on the combined common and preferred. This compares with $189,562 or $2.27 on the preferred stock alone in 1934.

Sangamo Electric was another company putting an increased rate into force, directors voting a quarterly of 50 cents, against 25 cents regular and 25 cents extra three months ago.

Earnings statements which make good reading continue plentiful: Anaconda Wire & Cable's 1935 net was $1,029,401, against $821,801 in 1934; Wagner Electric reports $835,947, against $314,330; McGraw Electric's profit rose to $614,369, against $502,950 a year earlier; American Transformer netted $15,361, against a loss of $4,146 in 1934; Apex Electrical Manufacturing's net was $198,439, compared with $11,530 in the previous year; Superheater and affiliates returned profit of $550,302, against $502,246; Electric Storage Battery, $2,247,755, against $2,004,404. Foster-Wheeler (excluding Foster Wheeler of Canada), however, had a loss of $541,545 after all charges, compared with a 1934 loss of $537,128.

•

Lynn Plant More Active

Employment in General Electric's Lynn, Mass., factories rose 720 last year. In addition, the work week was lengthened while an increase of 17 per cent in 1936 business is anticipated, according to Nelson J. Darling, plant manager.

•

Birmingham Dealers Push Refrigerators

Big things are promised in refrigerator sales in Birmingham, Ala., this year, with the spring campaign featuring large-scale co-operative advertising; Birmingham Electric Company buys about 60 inches of newspaper space once a week to stress low rates and the dealers insert smaller tie-in displays featuring the merchandise.

The Birmingham Refrigeration Bureau has a record to shoot at this year because of the high mark of 8,000 units valued at $1,188,000 in 1935, a 400 per cent increase.

New York Metal Prices

	Mar. 4, 1936 Cents per Pound	Mar. 11, 1936 Cents per Pound
Copper electrolytic	9.25*	9.25*
Lead, Am. S. & R. price	4.60	4.60
Antimony	12.625	13.50
Nickel ingot	35.00	35.00
Zinc spot	5.275	5.275
Tin Straits	48.00	48.25
Aluminum, 99 per cent	19—21	19—21

*Delivered Connecticut Valley.

Field Reports on Business

Reports to ELECTRICAL WORLD *from observers in the field indicate that business has been showing a steady, if slow, improvement so far this month despite the fact that production of electric energy is down in line with the usual seasonal trend. Favorable factors at the moment are higher steel and automobile production; the new federal tax bill and the war scare are unsettling.*

NEW ENGLAND

Steady improvement in the sale of electrical equipment compared with last year has been carried over in March without any outstanding order coming to the fore during the past week. Some negotiations are under way for heavy auxiliary equipment involving turbo-generators and small motor sales are being maintained in good volume. Orders for switch and control apparatus are good with an increasing tendency on the part of the utilities to buy.

Among the special electrical equipment sales of interest, prepayment meters are being bought and portable watt-hour meters are in good demand. Recently 5,000 of these were bought by a prominent refrigerator manufacturer. Electric arc-welding units are attracting attention among manufacturers of machine tools and machines where the application of surface hardening metal by the fusion process is gaining ground.

Interest in floodlighting apparatus is becoming more prominent and numerous playground improvement projects presage increasing buying of these units. Factory lighting is receiving attention, with more emphasis on gaseous tube lamps. Housing projects involve a promising amount of electrical equipment; one group projected north of Boston calls for complete air-conditioning of twenty high-class residences.

PACIFIC COAST

Numerous natural causes continue to assure increased business in the near future, the recent river floods even contributing their share, due to pumping and other reclamation work in the flooded and broken levee areas. This necessitates installation of large central motors and equipment as well as smaller individual efforts. P.W.A.'s $1,000,000 Boca Dam and the $3,500,000 Salt River Dam will produce considerable electrical equipment business.

Anticipating awakened interest in remote rural electrification due to the R.E.A., Pacific Gas & Electric has carefully surveyed the field and is ready to extend the system of cheapened construction lines which has already been successfully tried out this year. This company and Southern California Edison are staging intensive air-conditioning drives with the co-operation of all electrical branches. Commercial lighting is another line producing splendid results, especially in schools, banks and cafes.

Appliance orders have been appreciably diminished by various March taxes, but are practically guaranteed for the year by the report that the two principal branch bank systems in California are to take over the F.H.A. plan, expiring on April 1.

NEW YORK

The creeping advance in business, which has been clearly discernible since the first of this month, has continued this week, with automobile production rising sharply and the operations of steel mills again gaining moderately to the best rate of the year to date. Electric energy output, on the other hand, was slightly lower, although widening its margin of improvement over the like 1935 week a shade. Appliance movement continues in exceptional volume, aided by the moderate weather which has bolstered retail trade.

The most distressing spot in the business picture is the Administration's new tax bill, which threatens to abolish building of corporate surpluses to cushion the shock in times of bad business. The war scare, too, has had some repercussions, but the most important effect so far, aside from stock market jitters, has been to increase foreign demand for, and the price of, copper. Red metal quotations for foreign delivery have advanced steadily to cross 9⅛ cents and the buying, if maintained, bids fair to put the domestic spot price up to 9½ or better.

CHICAGO

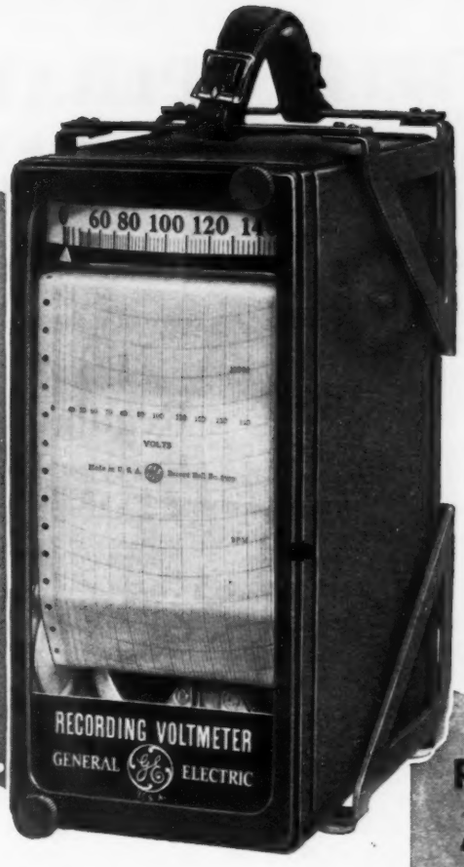
The beneficial effect of the emergence of business last week from the grip of the severe winter was overshadowed by the President's proposal to revise corporation income tax procedure. However, reports indicate that the trend is upward in all lines. Sales and construction activity increased perceptibly. Steel production in this area pushed further ahead and freight loadings rebounded to set a new high since November.

Electrical appliance sales showed a gain over the previous week and were approximately 15 per cent better than for the comparable period a year ago. The outlook for refrigerator sales is bright, with the expectation that last year's record showing will be bettered.

Manufacturers report no sizable orders for equipment, but total sales exceed the volume for the same period of 1935. Increased construction activity has benefited the contractor materially. With numerous building projects planned for spring, this prospective business should result in the increased purchases of wiring supplies.

NOW

A High-quality Strip-chart Recorder for Voltage Surveys



PRICED AT $80

HERE'S good news! General Electric now offers accuracy—performance—and quality—in a portable recording voltmeter, priced at $80 or $85.

Inexpensive Voltage Surveys

Maximum accuracy at minimum cost. That's what this recorder (Type CD-23 or CD-24) will give you. It is just right for voltage-survey work and offers an economical means to reduce power costs and equipment investment.

Its usefulness, however, may be extended to all fields that require accurate graphic records of circuit conditions.

High Electrical Accuracy

The electric element is designed to measure voltage values accurately and quickly. It is identically the same as the one in the more expensive CD-13 and CD-14 recorders. One per cent of full-scale accuracy can easily be maintained.

Reliable Chart and Recording Mechanism

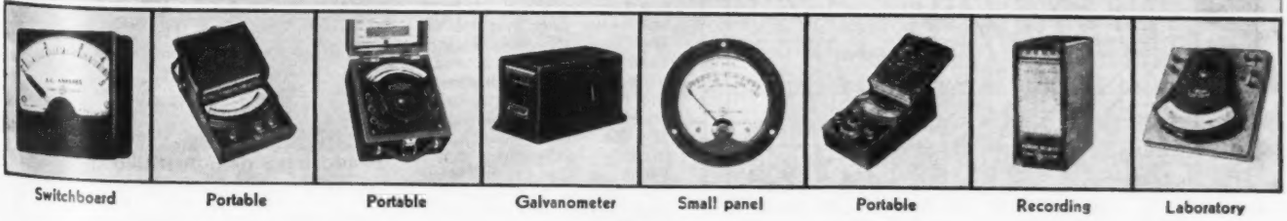
The mechanism is dependable. It is built to give years of trouble-free service without any loss in accuracy. A Warren Telechron motor drives the timing device in the CD-23 ($80); a spring clock is used in the CD-24 ($85). Both are single-range (0-150 volts) and single-speed "3 inches per hour" instruments.

Simplified

These instruments are basically the same as the well-known CD-13 and CD-14 recorders. However, certain features such as hinged window, double rating, and double chart speeds have been omitted. You get an instrument with sufficient adaptability for voltage-survey work, at large savings.

Be sure and write to your nearest G-E sales office for Bulletin GEA-2294, or to the General Electric Company, Dept. 6F-201, Schenectady, N. Y.

HEADQUARTERS FOR ELECTRIC INSTRUMENTS



Switchboard | Portable | Portable | Galvanometer | Small panel | Portable | Recording | Laboratory

430-59

GENERAL ELECTRIC

FIELD OPERATING PRACTICES

New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

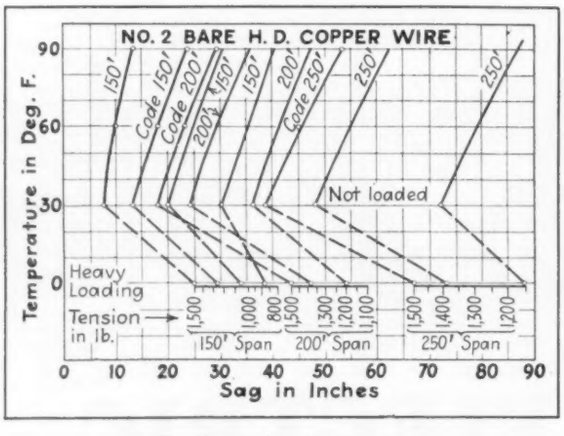
What's the Sag at Heavy Loading?

By B. E. ELLSWORTH
Engineer Iowa-Nebraska Light & Power Company, Lincoln, Neb.

On a bright, warm, sunshiny day the conductor sag in a transmission line span is so many inches. Then to what tension will these conductors be subjected when ice and wind load them heavily and the temperature is down to zero? If the sag is not exactly equal to the value given in the National Electrical Safety Code the answer to this question will require a lot of figuring.

One very practical use for this information is in guying telephone and railroad crossings. If the line has been in place any length of time the sags will be greater than code values, and as a result smaller guys will be found to be sufficiently strong. Sometimes the poles themselves are strong enough for crossing spans without any guys if the wire sag is sufficient.

It is, therefore, worth while to know sag values other than those in the code. But to calculate them every time they are needed is useless work. It is much more convenient to have them on a graph so the values for a particular instance may be determined by inspection and with practical accuracy. Here is one of the kind that has been made for the more common wire sizes and line spans on the transmission system of the Iowa-Nebraska Light & Power Company and has proved to be very useful.



To determine tension at heavy loading

If the point determined by observed sag and ambient temperature lies on the chart line corresponding to a given span length, then the tension at heavy loading and 0 deg. F. is read where the line hits the tension scale. But if the point does not lie on the line of span length, then the tension is read proportionately between the two span length lines on either side of the point. If the span length is largely different from those on the graph, then the tension would be approximated by interpolation between the values of tension for next longer and shorter spans. The lines marked "Code" have the same sag and tension values as given in the code.

•

Regulator Tests Prove Strength

By J. TURNER
Manager Transformer Department, Ferranti, Ltd., Hollinwood, England

One of the greatest limitations to the use of automatic voltage regulators in distribution circuits is their inability to withstand the mechanical forces due to severe line faults. Since in a normal distribution circuit the impedance is sufficient to limit a short circuit to about 25 times normal, one of the new Ferranti moving-coil regulators, illustrated, was subjected to several tests approximating these conditions. Oscillograms showed currents ranging from 27 to 30 times full load. After these tests the regulator was lifted from its tank and no signs of damage were detected.

Subsequent short-circuit tests were conducted at a voltage slightly above normal with no limiting impedance in the secondary circuit. Current values ranging from 55 to 57 times normal full-load value were recorded. Due to assymmetry or "doubling effect," the current at the instant of switching was in some cases considerably greater, the maximum being 77 times full-load value. Since the forces are proportional to the square of the current, 5,920 times normal full-load forces were obtained. Examination of the unit revealed no damage. It still operated mechanically and electrically in the usual way and has been shipped to the customer without alteration or adjustment.

Type of moving coil voltage regulator subjected to short-circuit tests

Voltage regulation obtained by isolated short-circuited coil moving up and down over an iron core carrying fixed coils. Owing to neutralization the mechanical forces on the coils — both fixed and moving — are extremely small. The low forces incidentally eliminate vibration and noise and permit operation of all but largest sizes by a simple induction-disk gramophone-type meter.

The foregoing tests were conducted on a standard automatic regulator designed to give variable boost up to 11½ per cent in a 50-kva., 240-volt, single-phase circuit. In all tests the moving coil was set for 10 per cent boost, in which position the worst mechanical forces are exerted.

•

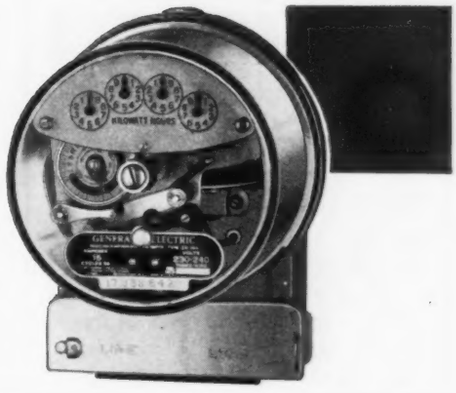
Knee Brace for Crossarms

By R. A. HAMMACK
Overhead Standards Engineer
Public Service Co. of Colorado, Denver

Two years' service on the system of the Public Service Company of Colorado have demonstrated the superiority of a new knee-type crossarm brace, particularly for supporting unbalanced loads. The new braces butt firmly against the sides of the pole instead of being merely attached to it. They are easier to handle and to in-

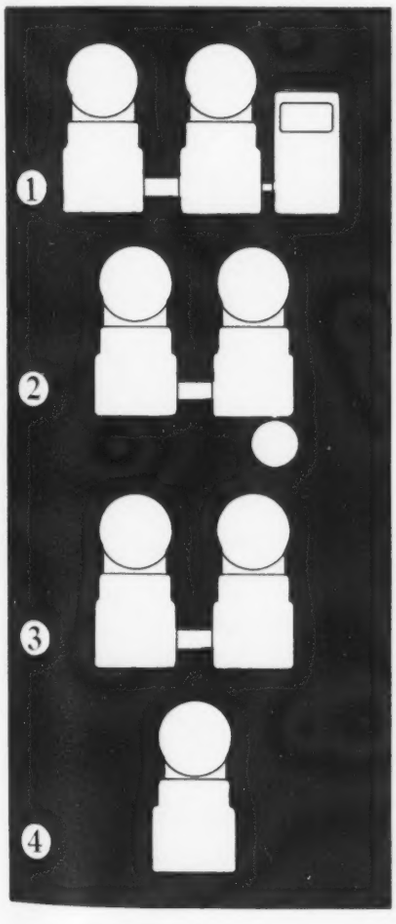
DOWN

GOES THE COST OF



WATER-HEATING CONTROL

NEW equipment reduces investment for the complete installation



HERE is graphically shown the progressive trend in the metering art—to meet definite requirements of electric-service companies for low-cost metering and control in connection with domestic load-building programs. At each step, the net result is better service to the consumer at lower cost.

(1) With the advent of off-peak water heating, one meter was required for the heater; another for all other loads; and a time switch for the off-peak control. A large capital investment.

(2) Then came the introduction, by General Electric, of the first time switch for simple, direct attachment to the service cabinet of the water-heater meter. Lower first cost; lower installation cost.

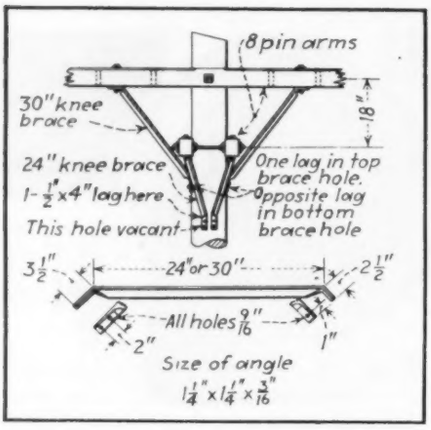
(3) Now General Electric offers the combination watthour meter and time switch, which eliminates the time switch as a separately installed item. It saves on investment, on space, on installation expense, and on stock inventory.

(4) And for those electric-service companies which have a two-rate system of charging, we introduce one unit. This has a double-dial register with contacts (where off-peak control is desired) or without contacts (where no off-peak control is desired) for use, in either case, where the entire load is metered together during the off-peak period. Thus, a single meter — the minimum investment!

This new combination watthour meter and time switch is available as Type IR-20-A (bottom-connected) and Type IR-20-S (socket-type). A G-E meter specialist, whom you can reach through the nearest G-E sales office, will gladly give you the complete story. Or write for a copy of Bulletin GEA-2312 to the nearest G-E sales office or General Electric, Dept. 6C-201, Schenectady, N. Y.

400-19

GENERAL ELECTRIC



Knee brace makes stronger structure

stall than the older type bow braces.

Two holes in the lower end of each brace permit attachment to the pole, but it is not intended to use two lag bolts. Tests have shown that one ½x4-in. lag screw is sufficient. Two holes were provided so that the lag screw in one brace could be put in the bottom hole and the lag screw in the opposite brace in the top hole, thus staggering them so there is no possibility of mechanical interference.

•

1 Meter for Single- and 3-Phase Loads

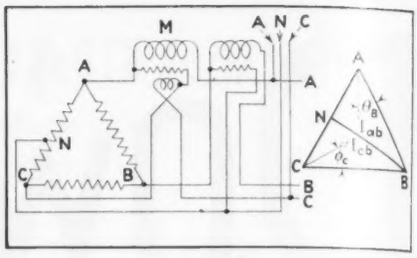
By W. G. PARMENTER
Superintendent of Meters,
Georgia Power & Light Company, Valdosta

It is well known that an ordinary two-element meter will not accurately register single-phase loads to a middle-of-phase neutral on a three-phase circuit if the power factor is not unity. In this connection the current coils are in the line wires which feed the single-phase load. One of the loads will be recorded negatively if the power factor is below 0.866; the load on the one side will register high at all lagging power factors, reaching a maximum of 400 per cent at 0.5 power factor.

For unbalanced voltage conditions analysis shows that the best accuracy is obtained if the single-phase load can be on the phase with the highest voltage.

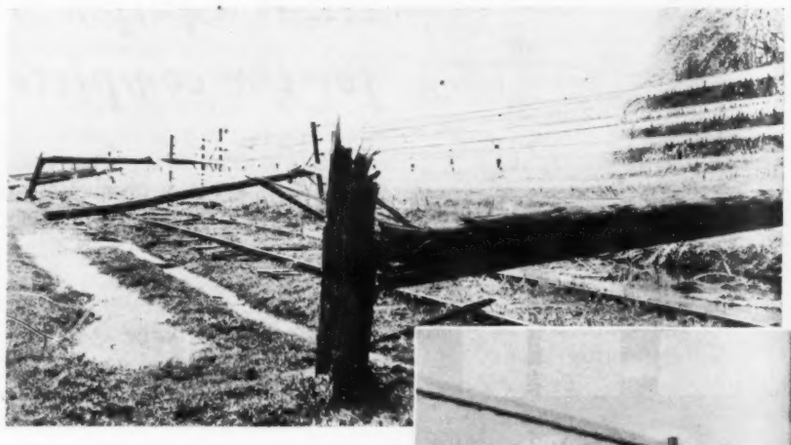
A three-element (two for three-phase load and one three-wire for the single-phase load) meter can be used or the special two-element meter which has one two-wire and one three-wire element. This latter form of meter can be shown to register accurately, when the voltages to neutral on the three-wire element are balanced, any load which can be connected between any of the line wires, regardless of any unbalance in the three-phase voltages. One way of looking at this metering scheme (see accompanying illustration) is to view the three-wire element as measuring all the single-phase load and half the three-phase load. The two-wire element then measures the remaining half of the three-phase load.

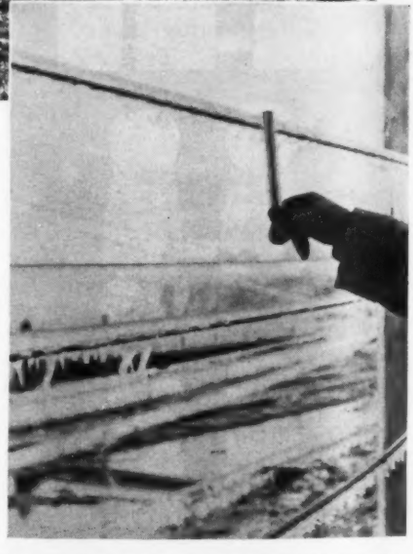
This suggests a convenient way of determining quickly how much of the load is three-phase and how much single-phase. Merely disconnect the potential from the three-wire element, time the two-wire element and take double the load its speed indicates. The amount of single-phase load is the difference between the three-phase load and total load.



Single- and polyphase loads segregated
Polyphase load is double that indicated by *N* when voltage leads to *M* are opened.

Sleet Works Havoc





One of the items of cost and of service often not considered is the effect of a sleet storm. These illustrations show what happened to lines in Ohio recently.

Top—Breakdown of 200-ft. span, 33-kv. line carrying two No. 2/0 and one No. 2 circuits.
Center—Not content with a 2-in. coating, a 12-in. curtain of ice hung down from the wire.
Below—Breakdown of a double-circuit, 33-kv. line carrying one No. 1/0 circuit, one No. 2/0 circuit and one No. 4/4-kv. circuit on 200-ft. spans.

POWER AT WORK IN INDUSTRY

New ideas and practices in industrial electrification as presented by industrial, consulting and power sales engineers

Refrigerated Storage Proves Load Builder

What may develop into one of the most desirable rural electrical loads is a new idea initiated from popular demand of Oregon and Washington farmers. Already it has developed considerable business for the operators of the new industry and appreciable load for the utilities in that area. Briefly, it consists of supplying refrigerated locker space where farmers can store perishable products either for future consumption or for a better market price. One store front sign says "Frank Ennis Cold Storage Lockers."

Refrigerated locker plants use 1,500 to 3,500 kw.-hr. per month

To correct abuses which might develop from misplaced or misappropriated articles certain areas of the building were divided into refrigerated locker rooms and the space rented for varying amounts, depending upon the size of the locker needed, the rentals varying from $5 to $12 annually. Normal temperatures in the lockers range between 5 and 10 deg. F. above zero and provision is made so that defrosting seldom raises temperature higher than 20 deg. above zero.

When animals are butchered for home consumption the meat can be stored in these lockers until wanted, several places providing the services of a butcher who will cut and wrap the meat into the various cuts for the table at a small charge. The farmer's wife has found the lockers a fine place to store fresh fruits by placing them in jars and covering them with sugar instead of canning them.

Practically all of the 30,000 lockers now installed in the Northwest are in use and additional units are planned where there is a demand for the services of this new industry.

•

Thirty Foot-Candles, No Windows in Mill

By ROY A. PALMER
Illuminating Engineer
Duke Power Co., Charlotte, N. C.

Hudson Silk Hosiery Company of Charlotte, N. C., recently constructed a new building which, excepting for a dormer in the center of the room, is entirely windowless. Officials of the company realized that, with air conditioning, windows were quite unnecessary to provide ventilation, and since daylight values drop so rapidly as the distance from even large window areas is increased, they did not contribute much to the illumination. It was the experience in one of their other mills having large window areas that the artificial lighting equipment was in operation practically all of the time. As a result, the new mill was constructed so that the working areas were illuminated with artificial light only.

The new building is one-story high, of brick construction, with a cork insulation covering the entire roof, and is completely air conditioned with a Carrier system. Because of the elimination of windows heat losses are reduced and, therefore, less furnace capacity is necessary. Likewise, saving is also made in cooling capacity.

Where windows are used daylight must be controlled at various times of the day to avoid glare from the sun or excessive brightness from the sky. It was experienced that curtains were never adjusted properly to suit all of the operators. When the glare was objectionable, time was taken to pull the curtains and when the sun had moved so that the brightness was gone the curtains often were not raised to take advantage of daylight. In many mills the practice of painting the windows is followed, which, of course,

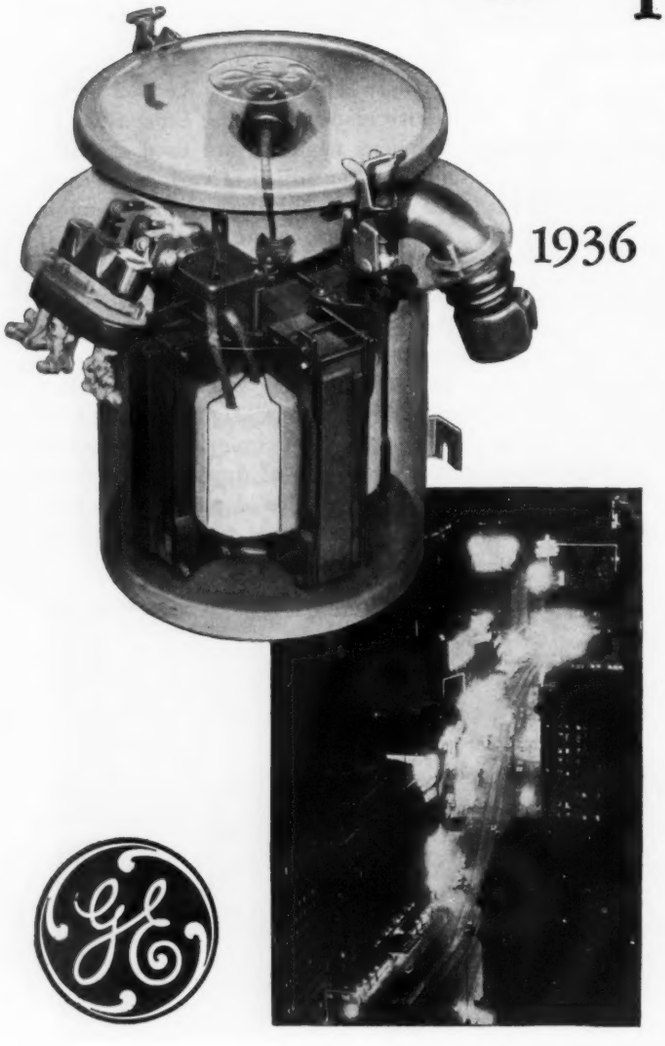
Exclusively artificial lighting permits constant, uniform illumination at all times

In this plant five 300-watt Holophane No. 685 units are used in each work alley. There are a total of 32 full-fashioned knitting machines in the room, making a total of 80 units, to which are added ten more over the looper tables. This installation is designed to provide levels of 30 ft.-candles at the needle points on the knitting machines. Each of the group of five lighting units is supplied by three No. 12 wires.

1886

Great Barrington, 1886

To William Stanley We Acknowledge Our Debt



1936

IN every generation there is at least one man who achieves one seemingly simple thing that has a major influence on civilization. Such a man was William Stanley, to whom, on the evening of March 20, the A.I.E.E. will pay tribute in a nation-wide series of celebrations commemorating the establishment of the first a-c system in America—which his work so largely made possible. We, of the electrical industry, pay tribute to his genius.

GENERAL

From a photograph
courtesy
Berkshire Courier

GENERAL ELECTRIC

Pittsfield, March 13, 1936

To the electrical industry we recognize our responsibility:

At Great Barrington, Massachusetts, in the spring of 1886, William Stanley's work on the transformer resulted in the first practical alternating-current distribution system in America. This was one of the major influences which made possible the phenomenal growth of electric service.

With the same foresight that the electric-service companies of America have shown in developing this service, they are now solving the technical problems involved in the present expansion of their distribution systems in order to meet the rising tide in industry, new home construction, and rural extensions.

From Mr. Stanley's first small transformer plant at Pittsfield has grown the Pittsfield Works of the General Electric Company, where with unmatched facilities for research and manufacture, our engineers and workmen have for more than forty years striven to achieve PERFECTION OF DETAIL and, as a result, have progressively built better and better distribution transformers.

The 1936 General Electric distribution transformer represents a degree of perfection in reliability and over-all economy far beyond any transformer ever before available. In accordance with our established policy we will continue to build better transformers, taking advantage of every opportunity, in new materials, new design knowledge, and better manufacturing processes.

L. R. Boyd

300-35

ELECTRIC

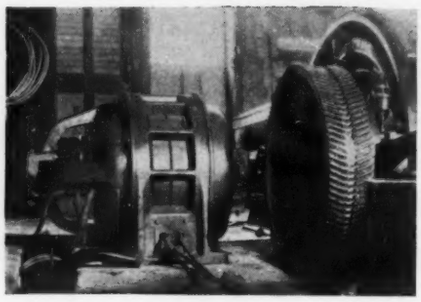
cuts down light transmission enormously, thus defeating the purpose of windows, but still leaves them as a source of heat loss. Side walls without windows eliminate these disadvantages.

•

Electrifying Old Gold Mine Hoist

By A. KANEKEBERG
Public Service Company of Colorado, Denver, Colorado

In many of the shaft houses of old mines that now are coming alive with gold at $35 an ounce the original hoisting engines still remain. Considering that they have lain neglected and without movement for twenty to thirty years or more, most of these engines are in surprisingly good condition. Iron rusts pretty slowly at 10,000 ft. up. After a good bath of penetrating oil and a little limbering up of the joints one of these old engines is just about ready to start lifting skips of ore as in the good old days, except that it's hardly safe to try to raise steam in the old boiler. So the connecting rods are removed from between the steam cylinders and the cranks, and by means of a pinion and bull gear an electric motor is hitched to the jackshaft driving the hoisting drum. New cable is bent through the sheaves and the hoist is ready to go to work. One customer left a steam cylinder connected to furnish air for his whistle.



Changing shaft hoist to motor drive

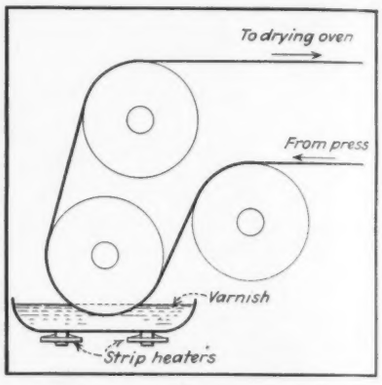
Slip-ring motor being installed. Note crank and piston rods removed from side of hoist and herringbone gear mounted on jackshaft.

This kind of application of today's drive to yesterday's machinery is popular among the revived mines for a number of reasons. The difficulty of replacing with new equipment, getting the new stuff in to the mine and the time required to set it up are important considerations to the mine operator who is impatient for production. And from the point of view of equipment suppliers, another thing to be kept always in mind is the fact that many of the mining operators are richer in hopes than in ready cash.

Strip Units Warm Color-Print Varnish

By H. R. STEVENSON
Detroit Edison Company, Detroit, Mich.

For best results in the application of the varnish coating which gives that nice sheen to high-grade lithography and other color printing the varnish must be held at a temperature of about 90 deg. F. Combustion and steam heat are frequently used, but the one is accompanied by apparent danger, while the other may require boiler operation at times for this alone. This is a "natural" for electric heat.



Varnish consistency maintained by electric heat

An almost standard technique, as appears in the accompanying sketch, has been worked out by the Detroit Edison Company for this application and already a number of installations have been made. Strip heaters of various sizes are used; on some of the larger coating machines are four 500-watt units. The heaters are mounted on the underside of the shallow varnish trough. By the movement of the paper through the varnish there is a continuous abstraction of heat, therefore thermostatic control is very desirable.

Light Increases Working Space

Here is a striking example of how adequate, properly applied light increases working space. Of course this room in the Colonial-Premier plant in Chicago is no larger than it was before, but the parts of it that formerly were filled with darkness are now available for working in. Before the Commonwealth Edison lighting engineers went to work the fixtures were widely spaced, haphazardly located. Certain benchwork areas had practically no light at all, less than 1 ft.-candle. Now the entire room is flooded with diffused light of 25 ft.-candles average intensity.

America's Most Beautiful Ranges
with the Sensational new "ECONOMIZER" that cuts electric cooking costs 18% lower
Westinghouse

Introducing New Ranges that will
ELECTRIFY AMERICA
Westinghouse Golden Jubilee Models combine new Beauty with amazing Economy and Convenience!
Westinghouse

TO HELP YOU MAKE 1936 *your* GOLDEN PROFIT YEAR...

sixteen pages of full-color magazine advertising are carrying the news of these amazing Golden Jubilee Electric Ranges and of Westinghouse ALL-ELECTRIC KITCHENS in the short period to April alone.

Inquiries from women are pouring in by the thousands. Retailers to whom these are forwarded are enthusiastic about the greatest sales successes they have ever enjoyed. GET INTO THIS FAST-MOVING PROGRAM RIGHT NOW. MAIL THE COUPON. See the 72-page range portfolio and the kitchen manual illustrated at the right, showing the greatest array of sales helps and plans ever presented to speed YOUR sales of electric ranges and complete electric kitchens.

ELECTRIC RANGES

Westinghouse Electric & Mfg. Co., Mansfield, Ohio

I want the whole story of your Golden Jubilee electri range and complete electric kitchen program. RUSH i to me.

Company.....

Attention of.....
(Title)

Address.....E.Wo-3]

NEW ENGINEERING IDEAS

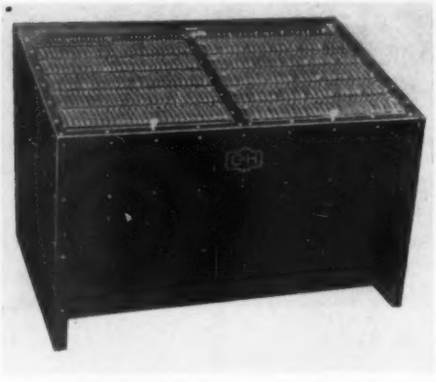
Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

Preset Stage Lights on Compact Console

By R. B. HUNTER
Cutler-Hammer, Inc.

Theater electricians who have long dreamed of operating their switchboards from "out front," where they could observe the performance from the viewpoint of the audience, can now do so. A new "double template control board," made by Cutler-Hammer, occupies a space small enough to permit its installation adjacent to the prompter's hood and allows the electrician to preset any desired combination of illumination intensities on any and all circuits by scenes or acts, and to run them off as the performance progresses.

Two control levers are provided for each circuit. One set of these levers is located on one control board and another on a second or duplicate control board. Both boards are combined in one stand. Templates or program plates are provided on which the illumination intensities for each act or scene are set up during rehearsal for each lighting circuit in use. These templates are used alternately; template for scene 1 is mounted on board No. 1 at the opening of the performance and the template for scene 2 is mounted on board No. 2. Pressing a button shifts all the control levers on the boards to positions determined by the templates. At the proper time a fader is used to transfer from scene 1 to scene 2 as fast or as slow as may be desired. Program plate for scene 3 then replaces that for scene 1 on board 1 and the controls are shifted to conform to the new template.



Double template theater dimmer board permits an unlimited number of presets to be made

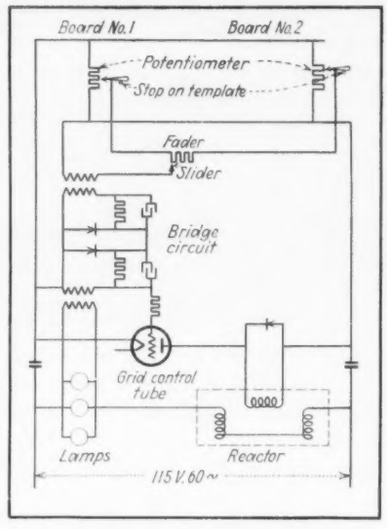


Diagram of control circuit for a single bank of lights

The accompanying diagram shows the connections for one circuit of a typical double template illumination control system using reactor dimming. From this diagram it will be seen that when the slider is at the left-hand end of the fader the lamp intensity corresponds to the setting of the potentiometer mounted on board 1. Moving it to the right end of the fader causes the lamp intensity to be determined by the setting of the potentiometer on board No. 2.

Each circuit of the switchboard consists essentially of two potentiometers and a fader, a bridge circiut for controlling the grid voltage supplied to a thyratron tube rectifier, a saturated reactor dimmer and the controlled lamp bank. Change from the setting on board 1 to board 2 (to increase the lamp brilliancy) applies an increased voltage to the bridge circuit, which in turn causes the grid control tube to pass current through the reactor coil, saturating the reactor and lowering its impedance and thus increasing the lamp voltage and brilliancy according to the preset value on board 2.

Other types of dimmers such as motor driven resistance inductor or transformer types may be used with the double template board as circumstances warrant, to replace reactor type here shown.

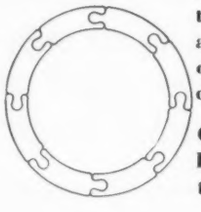
This board has reduced the space which is required for manually operated dimmer boards without preset to less than one-fifth that formerly necessary.

•

Transmission Cable Withstands Bullets

By D. M. SIMMONS
Chief Engineer
General Cable Corporation

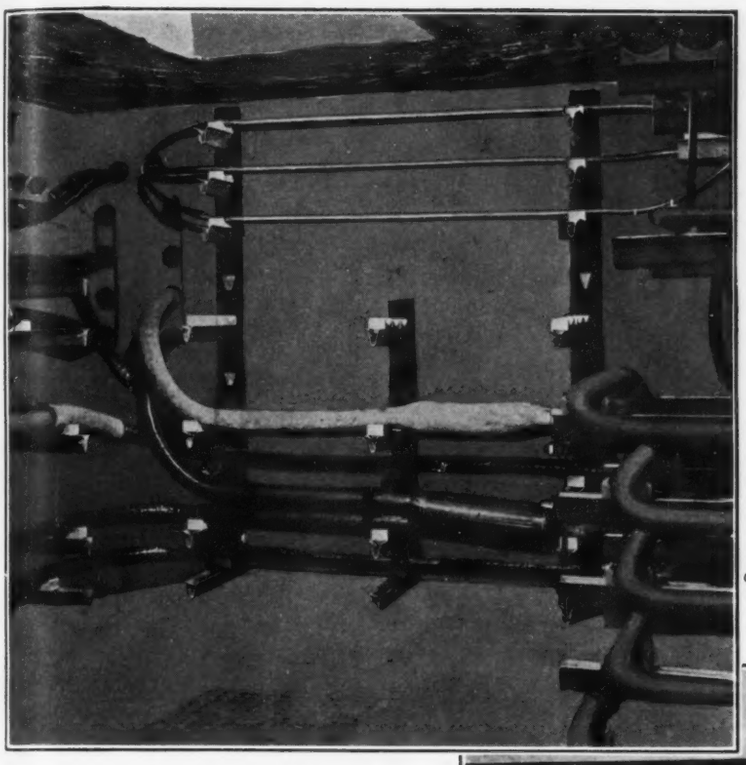
Rifle fire tests conducted by the General Cable Corporation on one of its type HH hollow copper conductors having a diameter of 1.1 in. and an area of 500,000 circ.mil indicate that there is no danger of damage from this source serious enough to cause line outage.



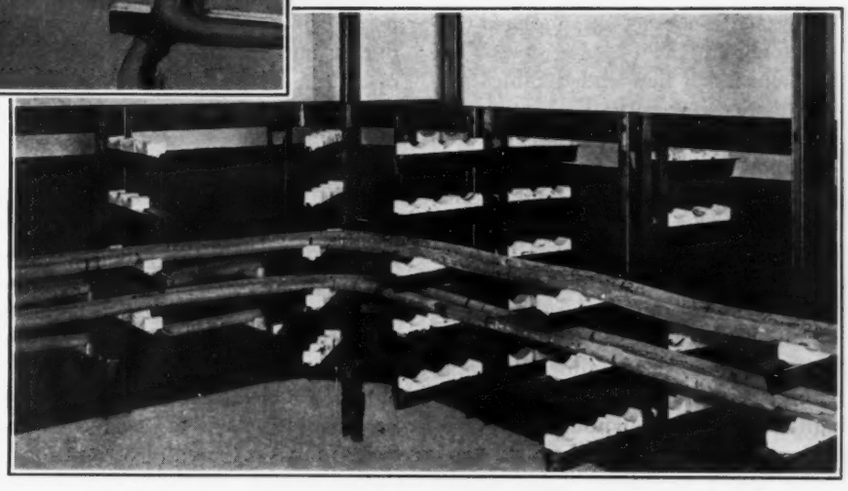
Direct hit on hollow transmission cable by army rifle fails to cause damage sufficient to cause failure

Cross-section of type HH cable showing interlocking construction

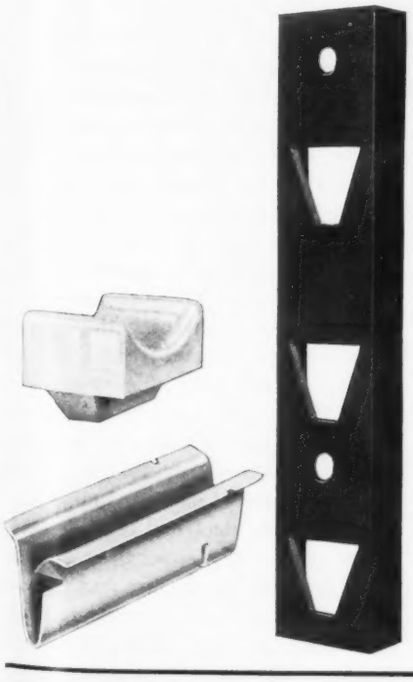
All gunfire directed at this cable, which is composed of eight tightly interlocked segments, was from an army Springfield rifle. Of the several hits recorded examination showed that most of these were glancing blows which did little more than nick one of the segments. One direct hit was obtained, however, in which the bullet penetrated and broke one segment. The bullet apparently tumbled, for



Cable Racks



Illustrations show Type "A" heavy duty porcelain insulated cable rack. We also manufacture light duty insulated racks as well as light and heavy duty non-insulated racks.



Whether you need cable racks for mounting cables in manholes, vaults, on station walls or in service boxes there's a Murray Rack for the purpose. And each type is durable, adaptable and easy to install.

Installations of Murray Cable Racks are extensive—we've been making them thirty years.

Without obligation, send for 12 page booklet illustrating various styles and listing standard sizes. Select the style you require—write for quotation, giving number of each part needed.

METROPOLITAN DEVICE CORPORATION
BROOKLYN — NEW YORK

MURRAY DISTRIBUTION DEVICES

upon emerging from the other side of the cable it broke two segments. This left five of the eight segments uninjured.

Nominal ultimate strength of this cable is 21,000 lb. With five segments solid the nominal ultimate strength should be about 13,000 lb. When tested the cable broke at 12,720 lb., or practically at its theoretical value.

Results of the test showed that if hit there is no danger that this type cable will be broken, damage is easily visible from the ground on inspection and there is no danger of unraveling of strands because of the tight interlock.

•

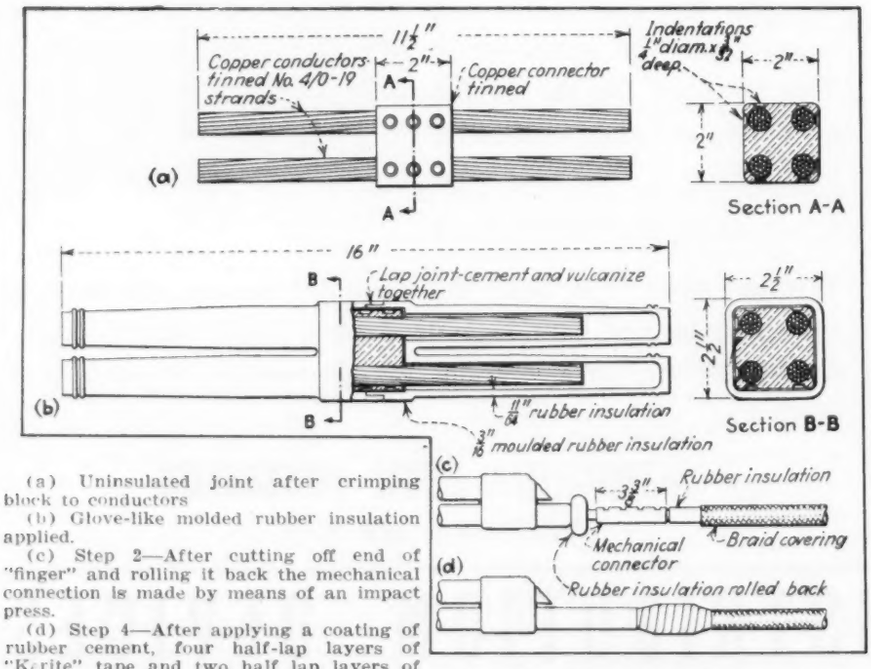
Crab-Joint Splices Non-Leaded Cables

Absence of wiping operations in conjunction with the absence of the metallic sheath of non-leaded cables permits dispensing with the heating pot and the solderpot also vanishes if a joint can be devised which connects copper to copper without solder. Such a splice has been devised for network application and it further eliminates the uncertainty of crotch taping by resort to factory-molded rubber insulation. Still further, this so-called "crab joint" makes possible additional services without opening up the main multi-conductor junction. The new device was described by C. P. Xenis of the New York Edison Company at a recent meeting of the New York Section A.I.E.E. (power group).

Four lengths of bare No. 4/0 stranded tinned copper cable are inserted through holes drilled into a square tinned copper connector. Steel dies mounted on a punch press grip the conductors in the block, making indentations into the face of the copper block. Two glove-like rubber pieces of molded composition are assembled at the factory over the bare crab joint and cemented and vulcanized at the top seam where they join. This constitutes the crab joint ready for installation in twin-circuit No. 4/0 secondary network mains.

The closed ends of the "fingers" beyond the ends of the copper conductors are cut off when a splice is to be made and the finger rolled back with the aid of a tubular tool to expose the conductor while the splicing sleeve is being crimped over the crab-joint conductor and the secondary lead. This operation is performed with one of two types insulated impact presses driven by gunpowder capsules.

In an experimental installation of 5,000 ft. of seven-conductor, non-leaded cables there were 350 crab joints employed lacking only the more recent roll-back features. Under adverse field conditions and high ambient temperature due to adjacent steam mains a year's operation has disclosed no electrical difficulties. Nor has inspection and dissection of random joints revealed deterioration of the insulation.



(a) Uninsulated joint after crimping block to conductors

(b) Glove-like molded rubber insulation applied.

(c) Step 2—After cutting off end of "finger" and rolling it back the mechanical connection is made by means of an impact press.

(d) Step 4—After applying a coating of rubber cement, four half-lap layers of "Kerite" tape and two half lap layers of friction tape complete the splice.

Network cable spliced with crab joint

Ammeters Facilitate Lathe Operation

Use of ammeters on a lathe—an innovation in machine tool design—has been adopted by the Porter Cable Machine Company and applied to its hydraulic cross-feed lathe as an aid to the operator in maintaining the most efficient feed and spindle speed. The design marks the opening of a new era in instrumentation of production machinery, bringing the instrument "dash" of the automobile to the production employee's assistance.

Ammeters on lathe head provide operator with information on efficiency of operation of the machine

Each of the two ammeters on the electrical head indicates current in one of the machine's two motor circuits: one drives the spindle and the other drives the hydraulic pump used in conjunction with the cross-feed. Pressure in the hydraulic cross-feed system is indicated on a pressure gage.

In addition to helping the operator maintain speeds and feeds that will result in maximum efficiency of machine and proper conditions of cutting tools these instruments also warn him of any electrical trouble before it becomes serious. Low cost maintenance results. This electrical head is a boon to the department supervisor, for with it he can check operator and machine at a glance, thus preventing excessive tool breakage costs. This is one of the major problems in departments operated on a piece price or premium basis, as the operator will use tools until they break rather than take the time to change when he should.

Appliance Merchandising in 1935

A Study of the Merchandising Activities of 103 Power Companies—What They Accomplished in Building Domestic Load and Revenue

For the fifth time in the past two years ELECTRICAL WORLD *presents a detailed statistical analysis of power company appliance merchandising on a national scale. Nearly a hundred and a quarter power systems are included. Twenty of them do no merchandising themselves. Eighty-three report on dealer sales as well as their own. And these data, in so far as power company appliance selling is concerned, give a coverage of about 75 per cent of the domestic consumers served by the industry.*

No conclusions are drawn. Here are the facts. They tell their own story. And it is a remarkable story, for the outstanding point is the wide diversity that exists in sales methods and proficiency between these different utility companies, all selling kilowatt-hours to American homes.

POWER company appliance sales increased 25 per cent last year in volume over 1934. This is a modest figure. But it hides some interesting and important facts. For water heater sales jumped 88 per cent and range sales 65 per cent. In other words, 1935 saw some notable progress in the direction of that greater domestic load for which all these utilities are striving. These percentages are reckoned on the dollar values.

On the following pages detailed facts are presented on the merchandising activities of 103 power companies. They operate in cities of all size, from as large as 771,375 to as small as 5,820 domestic meters, scattered throughout the country, and include practically all communities over 25,000 population. Together they serve a total of 10,872,187 domestic consumers, which was 3 per cent more than in 1934. This represents more than half the total number of households using electricity from all power systems. In so far as merchandising goes, it really embraces 75 per cent of the entire industry, because there are about 5,000,000 homes served by companies that do not themselves sell appliances. More than half of these are listed in the accompanying smaller tabulation of non-merchandising utilities. The balance comprise a half dozen other companies which were unable or unwilling to contribute their data to this compilation.

So the figures in this semi-annual

Domestic Appliance Sales by Power Companies

Total sales of household appliances by 103 power companies during the year 1935 together with their estimates of dealer sales in the same territories

Company	Total Domestic Consumers December 31	Av. Annual Domestic Kw.-Hr. Consumption		Av. Cost for Domestic Service—Cents	Average Revenue Per Consumer	Refrigerators Units Sold By Power Cos.		Refrigerators Units Sold By Dealers Pwr. Co. Est.		Ranges Units Sold By Power Cos.		Ranges Units Sold By Dealers Pwr. Co. Est.		Water Heaters Units Sold By Power Cos.		Water Heaters Units Sold By Dealers Pwr. Co. Est.		Clothes Washers Units Sold By Power Cos.		Clothes Washers Units Sold By Dealers Pwr. Co. Est.	
	1935	1935	1934	1935	1935	1935	1934	1935	1934	1935	1934	1935	1934	1935	1934	1935	1934	1935	1934	1935	1934
I—NORTHEAST—North of the Ohio River, East of the Mississippi River																					
1.	771,375	792	766	4.37	$34.58	5,661	5,069	.....	.....	8	.....	.....	.....	.....	.....	.....	.....	3,146	4,149	.....	.....
2.	[A]733,664	544	519	.....	.....	5,351	3,526	.....	.....	121	74	.....	.....	7	.....	.....	.....	7,335	8,279	.....	.....
3.	578,016	617	573	5.22	32.24	.....	.....	36,000	30,000	7,423	3,456	1,365	400	3,352	1,298	296	100	.....	.....	.....	.....
4.	[A]544,553	718	675	4.83	34.64	5,661	4,442	41,839	38,514	[B]2,946	1,673	572	899	[C]1,673	[C]878	116	114	3,170	3,516	43,980	87,900
5.	[A]508,319	761	719	3.97	30.22	1,127	992	.....	.....	4,875	2,950	.....	.....	[C]29	[C]26	.....	.....	849	980	.....	.....
6.	[A]410,534	511	486	6.21	31.74	4,496	3,117	.....	.....	2,825	2,278	.....	.....	.....	88	.....	.....	2,420	1,842	.....	.....
7.	319,500	643	626	5.35	34.38	2,655	2,323	.....	.....	1,323	738	.....	.....	147	167	.....	.....	1,800	2,013	.....	.....
8.	[A]305,374	554	530	6.53	36.40	3,733	2,764	10,926	7,650	2,523	1,318	512	258	744	459	91	33	2,31	2,009	16,146	.....
9.	[A]293,226	726	665	3.93	28.52	7,247	4,187	.....	.....	4,738	2,539	3,922	1,849	1,191	544	316	104	3,076	3,040	.....	.....
10.	[A]287,746	788	754	4.34	34.15	1,676	2,015	26,000	24,200	9	7	120	80	.....	.....	.....	.....	2,62	2,693	27,440	22,680
11.	[A]227,682	794	760	4.37	34.75	2,821	2,827	.....	.....	[B]930	[B]747	.....	.....	314	93	.....	.....	3,162	2,776	.....	.....
12.	[A]237,093	692	643	5.51	38.16	2,213	1,808	.....	.....	433	[B]186	.....	.....	195	[C]68	.....	.....	2,770	2,049	.....	.....
13.	202,489	816	707	3.60	29.37	681	520	6,500	6,500	751	74	712	946	452	51	232	567	1,437	1,699	.....	.....
14.	[A]201,280	728	656	3.80	28.10	1,082	1,132	21,300	19,000	[B]93	[B]42	39	95	[C]10	17	4	.....	1,019	959	4,000	4,000
15.	[A]159,419	499	469	6.75	33.69	1,769	1,434	.....	.....	114	63	.....	.....	.....	5	.....	.....	1,909	2,139	.....	.....
16.	159,148	748	666	4.18	31.26	4,692	3,023	2,500	2,000	2,729	1,176	416	236	845	270	21	6	2,879	1,979	1,500	1,000
17.	154,894	751	704	4.38	32.95	2,652	2,336	5,900	6,300	1,298	847	.....	.....	181	123	.....	.....	1,585	1,378	40,000	29,500
18.	[A]138,674	502	458	5.43	27.22	2,053	1,798	.....	.....	885	307	.....	.....	23	17	.....	.....	1,060	812	.....	.....
19.	[A]131,099	736	687	5.66	41.67	3,941	2,349	3,200	1,800	1,475	684	300	200	[C]651	327	100	50	1,133	938	1,500	1,200
20.	[A]128,737	602	543	6.30	38.00	344	739	8,783	6,021	385	401	2,272	597	456	57	831	55	61	136	9,549	7,157
21.	[A]114,892	478	435	6.50	31.05	1,670	1,110	3,404	2,017	1,480	721	84	62	650	336	7	17	724	1,073	.....	1,851
22.	[A]111,210	587	560	5.50	32.76	1,541	865	8,830	3,800	169	70	25	10	127	65	.....	.....	390	427	.....	.....
23.	[A]93,967	647	620	6.76	43.87	1,514	2,150	1,000	1,400	3	3	.....	.....	.....	.....	.....	.....	456	241	300	168
24.	[A]86,197	593	553	5.12	30.34	884	1,070	5,325	2,800	528	114	187	50	4	13	.....	.....	234	250	3,000	3,000
25.	[A]76,903	633	615	7.09	44.88	2,407	1,048	3,500	2,600	501	327	50	40	194	119	10	.....	833	644	3,000	2,500
26.	71,472	688	647	5.74	38.74	4,283	3,123	2,500	1,700	224	211	10	3	6	8	.....	.....	1,272	1,156	1,500	1,000
27.	[A]65,777	538	507	5.87	32.18	1,259	1,194	1,544	[G]876	1,442	1,489	53	[G]64	[C]352	[C]125	5	[G]5	1,372	1,597	1,200	.....
28.	[A]65,660	563	500	5.97	33.61	1,135	711	1,736	1,117	964	562	105	72	[C]852	292	82	55	616	708	.....	.....
29.	[A]64,791	571	516	5.44	31.07	207	71	.....	.....	418	109	.....	.....	22	1	.....	.....	118	103	.....	.....
30.	[A]52,005	634	587	5.44	34.51	1,797	1,432	1,500	900	915	762	65	50	64	40	.....	.....	1,445	1,141	.....	.....
31.	[A]48,685	750	675	4.18	30.64	1,952	1,310	1,600	1,000	368	153	5	4	211	50	6	4	745	643	900	700
32.	[A]48,202	531	483	6.06	32.22	1,104	993	1,439	1,130	932	789	213	88	76	35	1	7	736	712	.....	.....
33.	[A]47,945	584	541	6.50	38.18	1,105	403	1,979	1,876	462	152	77	54	333	29	24	10	175	140	2,873	3,150
34.	[A]41,640	420	404	7.26	30.49	1,015	603	1,338	850	103	86	34	44	3	7	.....	.....	286	252	.....	.....
35.	[A]39,988	567	549	5.75	32.63	636	572	1,500	1,200	576	351	40	30	[C]47	[C]17	.....	.....	696	833	.....	.....
36.	38,615	644	604	6.20	40.47	1,316	608	2,970	1,750	480	180	98	59	4	7	.....	1	57	29	924	.....
37.	[A]36,099	392	373	5.55	21.98	232	137	1,615	726	9	7	24	24	.....	.....	.....	.....	147	190	.....	.....
38.	[A]35,779	731	569	4.13	30.21	415	299	800	600	[B]230	78	.....	.....	[C]169	56	22	.....	297	371	.....	.....
39.	34,032	645	620	5.40	34.83	[S]245	277	1,599	719	[S]174	[S]344	154	121	[S]24	[S]57	8	2	334	358	300	300
40.	[A]33,351	500	459	5.90	29.53	1,166	361	400	150	357	192	100	30	123	89	15	10	494	235	700	500
41.	[A]30,460	696	646	5.61	39.08	478	451	.....	.....	72	58	.....	.....	14	2	.....	.....	660	490	.....	.....
42.	[A]21,646	573	486	5.18	29.73	509	207	2,300	1,500	14	3	3	.....	.....	.....	.....	.....	457	498	1,000	1,000
43.	[A]16,850	536	516	5.80	31.30	274	.....	565	.....	207	.....	44	.....	20	.....	.....	.....	185	.....	.....	.....
44.	12,216	512	494	6.10	31.21	88	60	266	158	183	67	50	15	74	46	2	2	164	163	3	0
II—SOUTHEAST—South of Ohio River, East of Mississippi River																					
45.	[A]131,664	1,039	888	3.63	37.67	[D]8,200	10,428	10,100	10,572	[B]4,154	[B]3,577	300	10	[C]2,826	[C]1,896	100	4	785	911	2,700	2,500
46.	[A]122,031	707	658	4.55	32.22	5,182	4,632	5,000	4,500	1,499	1,413	200	100	376	35	.....	.....	27	108	2,000	1,000
47.	[A]103,000	901	799	4.27	38.43	[D]208	188	9,130	7,130	[B]491	710	445	462	[C]106	222	60	71	.....	.....	.....	.....
48.	100,533	966	774	3.63	35.03	6,948	7,832	9,045	6,00	[B]4,925	[B]3,810	1,162	399	[C]2,242	[C]1,762	249	53	815	493	.....	.....
49.	[A]79,882	997	871	3.54	35.35	6,974	4,254	8,800	3,065	2,603	[B]1,269	397	262	1,145	[C]629	150	67	1,014	659	300	0
50.	[A]79,391	899	797	6.16	55.46	414	555	15,650	9,011	1,373	1,309	2,521	1,471	955	829	1,137	750	87	104	2,606	.....
51.	[A]69,000	541	479	6.18	33.41	851	701	3,696	3,848	798	1,010	199	236	270	387	38	17	.....	.....	.....	.....
52.	[A]68,247	619	578	5.25	32.50	1,519	1,076	3,500	3,100	66	99	10	2	6	6	.....	.....	[H]430	9	4,500	4,500
53.	58,060	858	681	4.60	39.76	3,028	1,997	4,883	.....	2,207	1,293	158	.....	1,080	555	40	.....	735	454	661	.....
54.	51,306	509	521	4.74	28.41	736	384	7,077	2,188	7	80	57	17	1	4	1	1	80	52	1,504	250
55.	[A]30,440	550	500	6.26	34.44	474	274	2,461	1,921	150	112	120	74	10	13	4	2	39	26	698	600
56.	29,006	562	501	6.69	37.60	955	341	1,427	835	[B]680	[B]101	[C]35	20	240	21	.....	.....	38	30	.....	.....
57.	[A]28,224	654	579	5.80	38.09	586	309	3,597	1,812	241	120	203	80	91	32	26	16	125	98	173	0
58.	26,532	655	594	5.21	34.05	1,669	812	1,500	400	509	134	.....	.....	337	106	.....	.....	224	63	100	0
59.	23,782	735	652	5.94	43.58	970	717	.....	.....	587	420	.....	.....	580	416	.....	.....	43	41	.....	.....
60.	[A]16,482	916	755	4.53	41.49	1,094	626	450	325	363	[B]113	75	10	267	[C]98	50	3	131	69	150	0
61.	14,433	857	747	4.40	37.60	[S]167	124	1,800	1,200	[S]419	[S]305	8	.....	[S]139	[S]86	1	.....	2	2	400	0
III—CENTRAL—West of Mississippi River, East of Rocky Mountains																					
62.	[A]308,019	685	611	4.99	34.19	4,275	2,194	15,800	10,738	4,014	1,904	1,376	322	3,010	1,405	735	224	844	1,078	13,500	11,000
63.	96,000	788	733	4.64	36.56	1,404	1,803	.....	.....	[B]646	[B]298	.....	.....	[C]82	[C]35	.....	.....	903	710	.....	0
64.	[A]77,468	489	478	6.70	32.75	690	362	2,495	1,714	.....	.....	.....	.....	.....	.....	.....	.....	580	576	5,669	4,500
65.	61,551	721	663	4.90	35.30	.....	1	9,102	5,352	8	9	32	31	.....	11	.....	.....	.....	5	2,047	1,500
66.	58,830	775	715	4.87	37.77	410	525	5,316	5,037	97	104	29	22	34	24	.....	.....	348	445	2,500	2,500
67.	55,609	685	637	4.85	33.21	261	58	6,572	4,985	238	75	93	65	3	2	2	3	147	41	4,809	4,000
68.	[A]49,000	604	573	5.00	30.20	1,084	913	.....	.....	67	45	.....	.....	10	3	.....	.....	853	1,066	.....	0
69.	47,078	617	552	6.10	37.65	1,584	1,034	4,868	3,437	602	340	24	19	172	114	3	2	545	440	1,080	0
70.	41,355	716	636	5.96	42.76	1,926	1,543	1,283	1,079	893	635	.....	.....	318	459	.....	.....	770	857	300	0
71.	[A]37,385	582	507	5.47	31.81	774	569	1,643	1,322	[B]62	[B]48	25	10	[C].....	[C]5	.....	.....	169	143	1,279	0
72.	37,325	764	659	5.55	42.43	1,898	1,283	4,077	2,261	1,201	[B]772	20	10	386	260	.....	.....	121	166	1,600	1,000

[A]Operate some gas service also. [B]Rent ranges. [C]Rent water heaters. [D]Rent small refrigerators. [E]Weighted average. [F]Straight line average. [G]Six months sales only. [H]Active selling latter part of 1935 only. [I]Includes E.A.R. from dealer sales of refrigerators. [J]Includes new business adv. salaries, supplies and expense, lamp adv. & demonstration.

nd Local Dealers for the Full Year 1935 (Continued)

Comparisons of these sales totals with 1934. With data on the average consumption, rates, revenue, appliance sales, salesmen, advertising expenditures—Embracing nearly eleven million domestic consumers

ning hines Sold by r Cos.	Ironing Machines Units Sold By Dealers Pwr. Co. Est.		Vacuum Cleaners Units Sold By Power Cos.		Vacuum Cleaners Units Sold By Dealers Pwr. Co. Est.		Misc. Small Appliances Units Sold By Power Cos.		Total Sales of All Appliances By Power Cos.		Annual Rev. Increase from Pwr. Co. Sales	Power Co. Appl Sales per Consumer	Power Co. Salesmen and Women on Domestic Load		Consumers per Salesman	Power Co. Advertising Expenditure		Advertising per Consumer
1934	1935	1934	1935	1934	1935	1934	1935	1934	1935	1934	1935	1935	1935	1934	1935	1935	1934	1935
I—NORTHEAST—North of the Ohio River, East of the Mississippi River																		
1,261	.....	.....	3,798	4,463	.....	.....	117,423	118,316	$3,596,139	$3,410,535	$300,000	$4.66	670	517	1,151	$483,129	$432,451	$0.63
2,027	.....	.....	5,330	4,887	.....	.....	55,635	51,577	2,376,359	2,177,122	.....	3.24	294	270	2,495	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	1,293,380	647,535	[L]1,155,260	2.24	130	125	4,446	95,000	90,000	0.16
685	3,870	1,370	1,023	1,907	17,420	27,240	22,761	21,962	2,226,943	2,004,500	547,000	4.09	216	190	2,521	224,514	227,471	0.41
363	.....	.....	657	862	.....	.....	41,775	32,822	933,993	707,952	.....	1.84	40	18	12,708	[J]351,191	[J]313,733	0.69
457	.....	.....	2,332	1,014	.....	.....	20,000	18,100	1,692,153	1,292,511	.....	4.12	.....	.....	.....	.....	.....	.....
372	.....	.....	1,397	1,251	.....	.....	28,311	25,408	1,062,037	879,293	285,000	3.32	[K]34	[K]28	9,397	137,600	144,300	0.43
227	61	.....	853	896	9,862	.....	17,199	14,958	1,551,693	1,340,802	281,589	5.08	250	208	1,221	180,000	125,000	0.59
662	.....	.....	2,957	2,817	.....	.....	32,581	20,664	2,573,645	1,695,199	.....	8.78	260	230	1,128	.....	.....	.....
878	8,000	7,200	1,729	2,015	22,000	20,000	14,625	14,444	962,153	879,623	169,732	3.34	40	37	7,194	34,421	37,462	0.12
159	.....	.....	2,007	2,452	.....	.....	17,202	19,356	1,491,975	1,344,088	.....	6.55	190	174	1,983	110,136	99,003	0.48
609	.....	.....	2,213	1,485	.....	.....	42,692	46,925	[L]1,127,554	912,371	175,000	4.76	68	61	3,487	100,000	91,000	0.42
109	.....	.....	1,445	1,407	.....	.....	25,000	21,000	743,700	560,700	130,000	3.67	55	50	3,682	65,000	67,000	0.32
166	1,400	900	1,544	2,413	6,000	10,000	60,800	60,500	623,438	608,760	58,000	3.10	74	78	2,720	.....	.....	.....
516	.....	.....	772	802	.....	.....	.....	.....	645,802	602,841	.....	4.05	.....	.....	.....	.....	.....	.....
621	600	400	1,515	1,158	1,400	1,200	8,312	8,785	2,054,411	1,297,012	.....	12.91	200	175	796	83,726	86,223	0.53
493	160	300	1,060	988	35,000	30,000	[M]15,892	[M]19,780	1,108,205	1,091,852	140,000	7.15	126	114	1,229	72,000	47,000	0.46
149	.....	.....	929	627	.....	.....	6,931	5,500	827,884	635,517	65,617	5.97	70	55	1,981	33,833	27,429	0.24
235	200	140	460	348	1,100	700	27,761	21,854	1,526,673	966,523	.....	11.65	[K]83	[K]76	1,578	73,305	47,900	0.56
45	189	138	.....	.....	.....	.....	.....	.....	154,351	252,855	534,266	1.20	46	32	2,799	32,642	9,527	0.25
179	10	27	.....	.....	.....	.....	.....	.....	686,926	468,476	111,844	5.98	70	50	1,641	.....	.....	.....
59	.....	.....	463	322	.....	.....	.....	.....	403,299	281,466	50,351	3.63	45	40	2,471	72,024	69,246	0.65
61	130	40	358	250	240	160	1,950	1,500	358,610	448,297	.....	3.82	25	30	3,768	.....	.....	.....
72	300	250	130	79	1,750	1,500	3,358	3,481	323,660	296,476	.....	3.75	19	17	4,537	44,515	39,365	0.52
118	125	100	916	838	5,000	4,000	2,833	2,631	739,535	480,073	162,050	9.62	36	31	2,136	55,997	44,390	0.73
207	100	75	529	493	750	600	7,500	6,000	1,295,473	1,161,914	250,000	18.13	125	90	472	56,626	40,370	0.79
349	150	.....	235	421	600	.....	.....	.....	646,761	632,260	94,984	9.83	30	34	2,193	30,180	22,258	0.46
150	50	29	1,160	370	3,000	2,500	.....	.....	622,734	395,429	90,125	9.48	49	40	1,340	29,587	23,365	0.45
11	.....	.....	173	143	.....	.....	5,630	1,970	167,407	65,230	20,840	2.58	10	10	6,479	.....	.....	.....
141	.....	.....	466	250	.....	.....	7,000	6,500	777,324	687,284	134,000	14.95	65	60	800	25,000	17,000	0.48
49	50	10	580	385	1,000	500	3,268	2,425	[N]575,271	[N]393,930	.....	11.82	30	20	1,623	.....	.....	.....
197	.....	.....	233	103	.....	.....	5,065	3,415	559,095	481,299	105,318	11.60	30	24	1,607	32,230	20,560	0.67
15	175	133	.....	.....	1,256	1,955	.....	.....	335,036	145,463	206,427	6.99	37	29	1,296	22,775	12,994	0.48
57	.....	.....	126	173	.....	.....	7,232	13,457	248,652	214,532	25,300	5.97	45	45	925	7,012	5,166	0.17
235	.....	.....	390	310	.....	.....	14,500	11,095	331,085	299,424	28,266	8.28	24	24	1,666	10,234	6,029	0.26
11	239	106	103	168	.....	.....	2,062	1,844	286,964	168,307	83,537	7.43	28	24	1,379	8,918	5,353	0.23
16	65	34	75	114	.....	.....	988	1,114	78,346	59,387	33,431	2.17	[K]6	[K]6	6,017	6,900	3,800	0.19
58	.....	.....	270	227	.....	.....	5,042	3,938	329,208	261,326	.....	9.20	26	26	1,376	7,017	6,166	0.20
62	52	55	244	301	200	200	10,064	4,716	225,636	180,684	108,993	6.63	37	37	920	11,479	12,102	0.34
14	25	14	836	233	836	233	2,037	1,916	362,951	141,262	64,300	10.88	19	16	1,755	11,452	8,995	0.34
50	.....	.....	545	623	.....	.....	.....	.....	326,514	296,060	45,500	10.72	20	19	1,523	16,768	11,387	0.55
45	8	8	263	169	125	200	1,332	952	218,880	145,576	15,000	10.11	11	10	1,968	6,587	6,106	0.30
.....	.....	.....	25	.....	.....	.....	916	.....	125,946	.....	28,346	7.47	9	.....	1,872	5,578	2,180	0.33
29	10	13	.....	.....	.....	.....	.....	.....	74,350	51,317	11,575	6.09	8	6	1,527	1,732	1,939	0.14
II—SOUTHEAST—South of Ohio River, East of Mississippi River																		
314	450	200	1,045	518	4,000	3,000	49,310	50,263	2,689,996	2,465,116	491,121	20.43	228	177	577	.....	140,000	.....
19	50	25	411	422	500	500	27,524	26,856	1,402,549	1,276,870	272,000	11.49	60	60	2,034	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	159,800	176,200	230,000	1.55	40	20	2,575	40,000	30,000	0.39
30	.....	.....	757	522	.....	.....	42,818	33,514	2,285,721	1,824,857	568,936	22.74	123	123	817	134,760	121,776	1.34
81	25	5	253	250	.....	.....	9,570	14,788	1,576,693	1,107,351	339,907	19.74	53	30	1,507	66,000	22,614	0.83
18	158	.....	43	63	1,291	.....	14,926	.....	397,459	442,535	117,461	5.01	42	38	1,890	111,000	110,900	1.14
.....	.....	.....	.....	.....	.....	.....	.....	.....	494,672	529,847	.....	7.17	35	35	1,971	40,000	65,000	0.58
203	100	140	[H]48	16	1,500	1,300	9,136	5,708	526,695	401,497	76,231	7.72	25	25	2,730	27,025	23,090	0.40
17	.....	.....	387	228	178	.....	8,449	6,359	1,122,791	791,321	.....	19.34	51	33	1,138	.....	.....	.....
2	97	50	259	376	143	66	15,690	10,206	260,634	239,131	61,669	5.08	56	50	916	[O]61,000	31,000	1.19
6	16	35	15	27	175	164	.....	.....	119,936	84,744	114,916	3.94	16	12	1,903	6,373	3,099	0.21
15	.....	.....	20	20	.....	.....	5,256	1,619	306,362	169,200	87,478	10.56	16	10	1,813	30,360	21,000	1.05
.....	6	.....	117	24	177	44	564	491	218,010	139,402	52,417	7.72	28	26	1,008	61,161	44,463	1.17
6	.....	.....	149	24	50	60	87,135	87,241	491,499	243,588	122,525	18.52	50	50	531	19,868	12,006	0.75
2	.....	.....	57	102	.....	.....	1,268	1,218	313,035	262,874	72,000	13.16	22	20	1,081	6,348	4,414	0.27
14	12	3	79	88	75	30	1,139	3,792	378,616	213,407	68,746	22.97	10	7	1,648	.....	.....	.....
.....	25	10	14	42	200	150	402	258	101,183	82,227	56,220	7.01	9	8	1,603	8,975	8,246	0.62
III—CENTRAL—West of Mississippi, East of Rocky Mountains																		
266	1,725	1,340	1,400	1,344	4,475	4,705	21,987	17,732	1,632,115	894,091	384,750	5.30	181	132	1,702	62,688	68,532	0.20
642	.....	.....	253	172	.....	.....	29,344	35,055	759,346	691,771	100,000	7.91	40	40	2,400	100,000	100,000	1.04
8	86	95	358	528	513	281	31,898	22,084	323,071	214,743	226,395	4.17	56	56	1,383	65,389	65,751	0.84
6	158	120	100	29	1,159	451	12,444	10,331	113,856	90,076	37,092	1.85	10	9	6,155	33,093	38,111	0.54
99	150	100	945	966	2,000	2,000	.....	.....	289,325	311,350	.....	4.92	.....	.....	.....	.....	.....	.....
.....	495	438	43	15	1,740	1,488	1,100	482	146,313	[F]56,093	22,097	2.63	24	20	2,317	29,944	25,130	0.54
20	.....	.....	802	774	.....	.....	4,933	3,500	436,860	404,861	.....	8.92	50	50	980	.....	.....	.....
34	21	20	197	271	.....	.....	.....	.....	456,371	378,931	63,292	9.69	32	31	1,471	11,085	17,207	0.24
143	9	4	320	210	400	300	.....	.....	592,529	580,707	96,904	14.33	50	50	827	25,919	19,750	0.63
41	76	21	189	250	904	467	5,583	3,563	244,000	189,000	68,756	6.53	28	15	1,335	20,000	18,000	0.53
3	20	10	124	125	200	150	10,571	7,750	528,750	391,479	87,744	14.17	54	39	691	29,927	23,249	0.80

s not include store salesmen. [L]Includes some ind. and com'l. sales. [M]Includes portable lamps and radio. [N]Includes some refrigerators sold as distributors. [O]Large part g rates. [F]For six months starting July. [Q]Including lamp bulbs. [K]Includes dealer sales. [S]Give trial period. [T]5-year rental purchase plan.

Domestic Appliance Sales by Power Companies

Company	Total Domestic Consumers December 31	Av. Annual Domestic Kw.-Hr. Consumption		Av. Cost for Domestic Service—Cents	Average Revenue Per Consumer	Refrigerators Units Sold By Power Cos.		Refrigerators Units Sold By Dealers Pwr. Co. Est.		Ranges Units Sold By Power Cos.		Ranges Units Sold By Dealers Pwr. Co. Est.		Water Heaters Units Sold By Power Cos.		Water Heaters Units Sold By Dealers Pwr. Co. Est.		Clothes Washers Units Sold By Power Cos.		Clothes Washers Units Sold By Dealers Pwr. Co, Est.	
	1935	1935	1934	1935	1935	1935	1934	1935	1934	1935	1934	1935	1934	1935	1934	1935	1934	1935	1934	1935	1934
73.	37,145	682	652	4.79	$32.67	199	157	921	473	347	189	124	77	193	24	6	2	284	260	1,049	1,103
74.	[A]32,220	786	713	5.20	40.99	3,375	2,472	1,310	1,019	359	610	20	20	423	612	.....	1	947	1,449	890	652
75.	[A]29,574	364	340	.....	.....	560	580	400	500	[B]50	26	.....	.....	[C]19	.....	.....	.....	300	280	500	500
76.	25,961	455	429	6.43	29.25	1,185	976	.....	.....	[B]12	[B]10	.....	.....	.....	.....	.....	.....	220	237	.....	.....
77.	24,200	690	670	4.87	33.62	445	287	500	600	[B]1,071	[B]702	50	25	[C]242	[C]53	.....	.....	93	25	.....	.....
78.	[A]22,820	610	544	5.92	36.07	489	262	1,578	931	425	250	54	15	161	71	6	3	255	266	2,075	2,098
79.	[A]22,067	520	500	6.60	34.37	618	314	1,125	836	43	55	42	23	9	9	6	24	305	247	394	400
80.	[A]21,119	571	517	5.65	32.22	95	38	1,462	1,457	339	180	30	58	42	34	4	1	249	143	1,508	1,467
81.	18,955	704	660	5.21	36.70	781	869	.....	.....	189	133	.....	.....	24	1	.....	.....	219	271	.....	.....
82.	18,885	870	757	4.40	37.20	328	212	904	586	[B]194	[B]65	13	16	[C]93	[C]52	2	2	36	45	.....	.....
83.	16,632	541	513	6.17	34.05	169	47	950	642	109	16	41	32	16	4	2	2	147	33	796	402
84.	[A]14,877	487	438	6.50	31.82	232	236	747	865	184	154	3	4	59	81	.....	.....	235	269	300	250
85.	[A]10,541	685	574	5.30	36.40	682	.....	1,168	525	[T]169	[T]75	.....	.....	[C]91	[C]40	.....	.....	.....	.....	.....	.....
86.	8,313	553	494	6.29	34.75	14	3	977	671	124	15	55	22	48	7	.....	3	38	2	285	192
87.	[A]7,239	530	500	5.86	32.50	95	87	100	87	4	8	4	8	.....	1	.....	1	85	113	67	113
88.	7,037	743	678	5.48	40.78	217	162	323	272	163	62	5	5	49	7	1	.....	125	142	406	375
89.	6,550	565	500	.....	.....	60	35	370	200	120	40	20	20	36	.....	4	.....	.....	.....	.....	.....
90.	[A]5,802	600	540	5.00	30.00	42	49	90	120	6	3	.....	.....	1	.....	.....	.....	89	106	150	150
IV—WESTERN—West of Rocky Mountains																					
91.	146,522	1,035	993	2.99	30.96	966	552	7,351	3,806	3,432	1,297	750	559	1,676	847	561	327	.....	.....	.....	.....
92.	101,995	1,046	993	3.02	31.61	832	552	8,068	5,000	1,434	818	1,436	475	1,034	708	.....	.....	434	432	8,232	6,000
93.	[A]100,247	534	502	5.88	31.81	1,521	1,223	.....	.....	314	196	.....	.....	15	17	.....	.....	914	1,013	.....	.....
94.	92,326	790	716	4.70	35.85	1,712	1,232	5,833	2,873	1,562	912	415	455	438	92	8	8	495	411	8,783	4,654
95.	[A]75,351	1,020	972	3.74	37.14	839	681	6,968	4,557	.....	.....	1,481	1,212	.....	.....	738	634	330	366	7,063	5,632
96.	[A]64,617	645	600	4.77	30.74	290	232	6,635	3,268	255	170	126	59	416	19	134	13	292	219	3,803	3,781
97.	[A]59,592	724	706	4.77	34.54	1,554	1,569	.....	.....	545	374	.....	.....	22	10	.....	.....	439	553	.....	.....
98.	52,862	1,665	1,570	2.31	38.42	[D]550	444	5,346	2,905	969	376	468	174	1,178	799	127	50	531	641	5,073	3,825
99.	45,649	1,287	1,236	2.99	38.50	618	635	3,715	1,728	1,058	486	485	251	821	376	187	144	1,054	1,050	4,287	2,473
100.	39,682	1,276	1,220	3.30	47.18	556	544	5,163	2,123	1,100	827	1,144	572	1,206	321	.....	.....	577	703	3,929	2,932
101.	38,204	980	896	3.86	37.58	1,307	852	2,000	1,500	1,527	1,183	.....	.....	283	165	.....	.....	698	690	.....	.....
102.	21,805	1,733	1,673	2.58	44.72	670	373	.....	.....	1,475	893	.....	.....	385	199	.....	.....	293	256	.....	.....
103.	20,561	623	591	5.66	35.24	415	316	1,000	800	[B]432	124	10	10	75	58	.....	.....	155	284	600	500
Total	10,872,187	[F]702	[F]645	[E]4.83	[F]34.94	162,784	126,982	414,934	301,030	93,606	56,742	25,918	14,094	37,380	19,904	6,571	3,570	76,328	74,792	258,581	241,623

[A]Operate some gas service also. [B]Rent ranges. [C]Rent water heaters. [D]Rent small refrigerators. [E]Weighted average. [F]Straight line average. [G]Six months sales only. [H]Active selling latter part of 1935 only. [I]Includes E.A.R. from dealer sales of refrigerators. [J]Includes new business adv. salaries, supplies, and expense, lamp adv. and home demonstration.

survey of appliance sales for the full year 1935 may be taken as covering two-thirds of the consumers in the country who purchase energy from public utilities that sell appliances. These 103 companies last year sold $66,914,964 worth of domestic appliances, against $55,155,943 in 1934. This checks well against mass totals just compiled by the Edison Electric Institute, on the aggregate appliance sales of practically the entire industry. The E.E.I. figures, a single total embracing all types of appliances sold, are as follows:

1935	$86,727,000	1932	$57,889,000
1934	73,244,000	1931	112,850,000
1933	53,895,000		

These totals are based on reports from about 85 per cent of the industry and projected to cover the remainder. They include lamp bulb sales, which in 1935 amounted to $5,121,000. They show that though 1931 was the peak year in dollars, more refrigerators, ranges and water heaters were sold in 1935. Prices were lower.

The 103 power companies covered by this study showed gains right down the line over 1934. They sold 28 per cent more refrigerators, 65 per cent more ranges, 88 per cent more water heaters, 2 per cent more clothes washers, 10 per cent more ironing machines, 7 per cent more vacuum cleaners and 12 per cent more miscellaneous and small appliances. As already noted, the effort was clearly concentrated on the three major load builders.

And sales by the dealers in the territories reported by these companies ran the same way. These dealers sold 38 per cent more refrigerators, 84 per cent more ranges, 84 per cent more water heaters, 7 per cent more clothes washers, 46 per cent more ironing machines, 10 per cent more vacuum cleaners and 10 per cent more miscellaneous and small appliances. The dealers showed a better gain than the power companies on refrigerators and ironing machines.

Of the 103 utilities reporting, estimates on dealer sales were provided by 83 on refrigerators, 74 on ranges, 50 on water heaters, 61 on clothes washers, 60 on ironing machines, 51 on vacuum cleaners and 39 on small appliances. In most of these territories, where no dealer range or water heater sales were reported, the dealers are probably not selling these two appliances. But in the case of the other appliances it just means that these power companies do not check on what their consumers are putting on the lines and they do not know what the dealers are selling them.

In the territories covered by reports on both utility and dealer sales the power companies last year sold 24 per cent of the refrigerators, 75 per cent of the ranges, 84 per cent of the water heaters, 12 per cent of the clothes washers, 28 per cent of the ironing machines, 14 per cent of the vacuum cleaners and 22 per cent of the small appliances. And the figures on ironing machines stick out like a sore thumb, because this appliance builds load and is still in its pioneering stage. It needs more support if it is to win popularity soon and become profitable, fast-moving merchandise.

All this makes a very pretty picture, for it means a large increase in annual revenue to the power industry at a

and Local Dealers for the Full Year 1935 (Concluded)

Ironing Machines Units Sold by Power Cos.		Ironing Machines Units Sold By Dealers Pwr. Co. Est.		Vacuum Cleaners Units Sold By Power Cos.		Vacuum Cleaners Units Sold By Dealers Pwr. Co. Est.		Misc. Small Appliances Units Sold By Power Cos.		Total Sales of All Appliances By Power Cos.		Annual Rev. Increase from Pwr. Co. Sales	Power Co. Appl Sales per Consumer	Power Co. Salesmen and Women on Domestic Load		Consumers per Salesman	Power Co. Advertising Expenditure		Advertising per Consumer
1935	1934	1935	1934	1935	1934	1935	1934	1935	1934	1935	1934	1935	1935	1935	1934	1935	1935	1934	1935
160	87	120	72	182	256	547	336	8,502	7,467	$203,900	$129,600	$106,131	$5.49	45	33	808	$64,329	$41,353	$1.73
66	201	62	49	187	283	.....	.....	.....	.....	938,187	826,004	211,130	29.12	55	49	587	.....	.....	.....
35	35	.....	.....	400	300	500	500	.....	.....	200,000	200,000	35,000	6.76	30	20	986	15,000	12,000	0.51
10	3	.....	.....	157	147	.....	.....	1,698	1,408	311,898	263,170	50,484	12.01	26	20	998	20,989	18,296	0.81
16	3	.....	.....	34	22	.....	.....	1,262	1,135	249,000	180,000	.....	10.29	10	7	2,420	3,000	2,000	0.12
54	52	116	90	167	.....	.....	.....	3,403	.....	[L]224,157	146,354	31,479	9.82	34	31	612	.....	9,910	.....
4	3	.....	30	44	114	69	250	17,164	15,000	181,928	115,920	.....	8.24	15	14	1,471	15,184	22,068	0.69
106	133	39	74	.....	.....	.....	.....	239	.....	138,208	69,313	43,470	6.54	24	16	880	8,665	5,606	0.41
25	34	.....	.....	206	376	.....	.....	1,702	1,541	242,413	265,077	36,542	12.79	21	18	903	34,270	29,224	1.81
4	3	.....	.....	65	79	.....	.....	3,134	2,860	108,881	85,541	20,340	5.77	12	12	1,574	16,203	19,274	0.86
41	7	44	27	52	.....	.....	.....	953	.....	75,488	23,914	9,326	4.54	21	14	792	6,003	2,604	0.36
46	52	6	.....	125	136	150	100	.....	.....	81,824	78,279	14,952	5.50	12	9	1,240	4,653	3,797	0.31
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	184,269	44,757	45,000	17.48	15	10	703	7,562	5,165	0.72
20	.....	12	12	.....	.....	.....	2	835	280	43,617	10,747	8,008	5.25	6	2	1,386	1,783	689	0.21
13	17	12	17	168	129	168	129	1,684	1,500	58,822	61,055	4,030	8.13	9	9	804	2,573	2,681	0.36
25	16	12	3	.....	.....	.....	.....	.....	.....	87,049	68,006	12,437	12.37	9	8	782	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30,000	14,000	.....	4.58	2	2	3,275	.....	.....	.....
10	7	20	10	109	80	60	60	593	540	45,973	40,000	17,406	7.92	7	6	829	4,424	3,983	0.76
IV—WESTERN—West of Rocky Mountains																			
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	838,627	330,998	250,648	5.72	80	30	1,832	.....	.....	.....
119	145	100	50	163	213	2,954	2,000	7,043	5,306	599,376	402,672	112,085	5.88	55	29	1,854	53,265	38,477	0.52
224	209	.....	.....	1,127	1,067	.....	.....	12,572	12,738	706,640	648,180	.....	7.05	65	60	1,542	83,457	76,283	0.83
110	74	352	206	863	764	4,260	3,702	8,755	5,634	815,817	626,920	136,845	8.84	49	47	1,884	70,000	60,000	0.76
85	80	1,310	730	157	237	2,610	3,565	8,813	8,265	296,980	266,380	253,833	3.94	38	37	1,983	11,341	18,204	0.15
145	80	720	405	211	273	1,954	1,127	3,892	3,148	236,153	139,973	119,060	3.65	14	12	4,616	48,300	41,208	0.75
95	104	.....	.....	480	361	.....	.....	[Q]266,132	[Q]227,535	611,921	550,560	93,000	10.27	40	20	1,489	32,000	27,000	0.54
.....	.....	.....	.....	594	684	2,269	1,850	5,132	4,953	438,996	336,728	[R]359,943	8.30	28	21	1,888	65,486	54,000	1.24
366	206	315	99	171	180	1,046	554	.....	.....	448,781	349,114	110,000	9.83	42	38	1,087	36,127	33,346	0.79
147	117	360	75	281	241	622	518	9,538	4,995	490,617	387,587	95,441	12.36	67	51	592	23,297	12,336	0.59
125	104	.....	.....	159	198	.....	.....	3,121	3,212	485,451	411,419	129,350	12.71	25	24	1,528	17,659	14,325	0.46
71	56	.....	.....	54	24	.....	.....	811	796	330,674	228,800	82,250	15.17	22	21	991	9,830	8,836	0.46
36	30	10	10	228	163	500	400	4,382	4,992	168,949	138,543	.....	8.23	12	12	1,713	3,600	3,500	0.18
1,570	16,066	23,258	15,917	54,910	51,497	144,928	131,237	1,398,084	1,245,020	66,914,964	53,155,943	11,718,498	[S]6.16	5,930	4,974	[S]1,833	4,189,023	3,783,773	[S]0.39

[Q]Does not include store salesmen. [L]Includes some ind. and com'l. sales. [M]Includes portable lamps and radio. [N]Includes some refrigerators sold as distributors. [O]Large part for ling rates. [P]For six months staring July. [Q]Including lamp bulbs. [R]Includes dealer sales. [S]Give trial period. [T]5-year rental purchase plan

time when it is sorely needed. The 83 companies that reported the estimated annual revenue expected from the sales made by them show an aggregate gain in gross income of $11,718,498 as a result of these merchandising operations. And this does not embrace the current consumption of all the appliances sold onto their lines by the dealers. But when you look into the results obtained by individual companies, the poor showings as well as the good ones become conspicuous.

The average appliance sales per domestic consumer run all the way from one case of $29.12 in the Middle West and highs of $22.97, $20.43 and $9.74 in the Southeast to lows of $1.85 in the Middle West, $1.84 and $1.20 in the Northeast and $1.55 in the Southeast. Surely this is too great a spread between companies that are actively selling appliances.

At the same time the annual domestic consumption averages as of December 31, 1935, reported by these companies show the same wide divergence in the extent of the domestic load which has been built up on these systems over the past year. Here we have highs of 1,733, 1,655, 1,287 and 1,276 kw.-hr. per residence customer in the far West, where range saturation has been developed beyond the balance of the country, and highs of 1,039, 997, 966, 916 and 901 in the Southeast, where merchandising has been so active in the last several years under the pressure of the T.V.A. threat.

We also find 816, 792 and 788 in the Northeast and in the Central area 870 and 788. But from there they go "down, be-low, be-low" like the music, into the 600s, 500s and 400s, the depths being struck by a 392 in the Northeast and a 364 in the Central area.

Some splendid increases in average annual domestic consumption are recorded. There were gains of 192, 177, 161 and 151 kw.-hr. made in the Southeast and a gain of 162 by one Northeastern company. These represent percentage gains of 25, 26, 21, 17 and 28, respectively, in the growth of domestic usage on these systems.

The average cost of the service to the customer runs all the way from 7.26 down to 2.31 cents per kilowatt-hour. The average revenue per domestic consumer shows highs of $55.46 and $43.48 in the Southeast, $47.18 and $44.72 in the far West and $44.88 and $43.88 in the Northeast and $42.76 and $42.43 in the Central area. There are lows of $28.52 and $28.10 in the Northeast, $28.41 in the Southeast, $30.74 on the Coast and $29.25 in the Central area. In all, 55 companies reported an increase in average revenue per domestic consumer. The balance were probably all affected by rate reductions in 1935, from which they had not yet recovered, by load building.

To accomplish all this, these utilities employed 956 more salesmen and women in 1935 than the year previous. This was an increase of 19 per cent, though it does not allow for one company that reported on personnel for 1935 only. But they employed only nine men. One company took on 50 more people, an increase of 167 per cent in the selling staff. Another added 49, a jump of 37 per cent; another 153, a jump of 29 per cent; an-

Table I—Trends in Appliance Rental

Detail of rentals by companies in tabulations indicated as engaged in rental of appliances.

Company	Ranges Rented 1935	Ranges Rented 1934	Water Heaters Rented 1935	Water Heaters Rented 1934	Refrigerators Rented 1935	Refrigerators Rented 1934
4	2,980	....	885	1,070	....	....
5	....	....	201	182	....	....
11	495	1,282	....	....	....	....
12	....	424	....	88	....	....
14	346	400	47	....	....	....
19	....	....	58	....	....	....
27	....	....	105	200	....	....
28	....	....	89	....	....	....
35	....	....	6	15	....	....
38	2	....	90	....	....	....
45	29	*—204	31	11	1,196	....
47	2,456	....	2,381	....	575	....
48	122	307	96	199	....	....
49	....	25	*—3	16	....	....
56	182	63	73	....	....	....
60	....	74	....	73	....	....
63	1,082	756	434	381	....	....
71	455	278	591	236	....	....
72	....	98	....	....	....	....
75	25	....	4	....	....	....
76	140	42	....	....	....	....
77	498	1,015	287	115	....	....
82	353	495	292	423	....	....
98	....	....	....	....	119	....
103	15	....	....	....	....	....
Rentals by companies that sell no appliances						
2	....	....	1,070	805	....	....
9	431	246	46	58	....	....
12	1,042	625	450	365	....	....
18	10	1	....	....	....	....
Total	10,663	5,928	7,233	4,237	1,890	....

*Reduction in number on rental.

other 51, or 29 per cent more, and another 42, or 20 per cent more.

The same old divergence shows in the number of customers a salesman is supposed to cover. It runs in 1935 from highs of 12,708, 9,397 and 7,194, all in the Northeast, to lows of 472 in the Northeast, 531 and 577 in the Southeast, 587 in the Central area and 592 in the far West. There is a bit of encouragement in this, however, for in the similar ELECTRICAL WORLD tabulation for the year 1934, published on March 2 last year, there was one case where one salesman was supposed to cover 25,938 consumers.

These companies last year expended $4,189,023 for advertising to build domestic load, which was 11 per cent more than in 1934. Some companies spent as high as $1.81, $1.73 and $1.34 per domestic consumer and some as low as 15, 14 and 12 cents.

And some of them offered major load builders on a rental proposition as an inducement to accelerate sales. In a word, 15 companies rented 9,180 ranges, which was an 81 per cent increase in rentals by them over the year previous. Also, sixteen companies rented 5,667 water heaters, which was 88 per cent more than they rented in 1935. Also, three companies rented 1,890 small refrigerators, whereas none were reported by them for the year before. Gas service was provided to some extent by 61 of the 103 power systems reporting.

Table II—Unit Sales of Domestic Appliances

Based on companies that estimated dealer sales

Appliance	Power Company Sales, per Cent	Dealer Sales, per Cent
Refrigerators	24	76
Ranges	75	25
Water heaters	84	16
Clothes washers	12	88
Ironing machines	28	72
Vacuum cleaners	14	86
Small appliances	22	78

All this applies, of course, to utilities that are actively selling domestic appliances at retail. The smaller table of twenty companies, that do no merchandising themselves, shows some interesting comparisons. Their annual domestic consumption averages run from 1,177 to 489 and their domestic revenue averages from $45.03 to $26.20. It shows little difference from the situation of those companies that are actively selling. It would appear, however, that the utilities which are merchandising are moving ahead more rapidly, for among the companies which are leaving all the appliance selling to the local trade there are no spectacular gains in growth of average consumption. The largest increases over 1934 were 114 and 105, or 13 and 10 per cent, respectively.

These utilities appear to have no more knowledge as to what the dealers sell onto their lines than those that are in the retail business themselves. Dealer sales are reported by sixteen on refrigerators, fifteen on ranges, eleven on water heaters, eight on clothes washers, nine on ironing machines, eight on vacuum cleaners and six on small appliances.

No attempt is made, however, to draw any other comparisons between the merchandising and non-merchandising companies or between the individual systems listed in the large tabulation. Local conditions as to load and rate and sales proficiency are reflected, but many other conditions are involved which cannot be indicated in such a survey. But the figures tell a story of success—or lack of success—in building load and revenue and are worth studying.

Table III—Where the Power Companies Sell No Appliances

Consumption, growth of load, average rate, revenue and salesmen and advertising per consumer reported by a group of utilities that do not themselves merchandise.

Company	Total Domestic Consumers 1935	Total Domestic Consumers 1934	Av. Annual Domestic Consumption 1935	Av. Annual Domestic Consumption 1934	Av. Annual Dom. Revenue 1935	Av. Rate Dom. Service 1935, Cents	No. of Salesmen 1935	No. of Salesmen 1934	Advertising Expenditure 1935	Advertising Expenditure 1934	Advertising per Consumer 1935
1	645,877	638,709	493	481	$30.40	6.16	98	89	.....	.....	....
2	[C]583,611	549,911	[E]763	[E]722	31.46	4.13	261	244	$200,257	$153,210	0.34
3	[C]542,699	527,185	761	715	31.56	4.15	[F]160	...	[G]177,566	[G]131,072	0.32
4	396,157	395,910	738	691	29.26	4.20	130	100	160,000	129,990	0.40
5	300,092	294,923	561	546	33.62	5.99	...	...	.....	.....	....
6	146,009	140,811	1,008	941	33.53	3.33	17	19	.....	.....	....
7	[C]111,494	111,067	602	569	42.72	7.10	4	4	.....	.....	....
8	94,278	91,167	648	603	37.58	5.80	11	11	40,000	40,000	0.42
9	[C]79,690	75,880	[DE]611	[DE]570	33.14	5.42	10	8	.....	.....	....
10	[C]77,681	76,067	674	621	28.52	4.23	1	1	10,000	7,500	0.13
11	73,426	72,010	682	643	34.80	5.10	31	23	25,813	21,170	0.35
12	58,972	57,935	[DE]973	[DE]859	39.87	4.10	22	19	41,000	29,000	0.70
13	[C]56,069	54,625	760	693	41.26	5.40	28	25	20,000	20,000	0.36
14	[C]51,661	50,221	528	502	26.20	4.97	...	...	17,782	15,842	0.34
15	[C]50,230	48,835	680	642	37.79	5.55	10	6	30,000	28,000	0.60
16	32,577	31,690	1,177	1,165	32.03	2.72	21	10	41,215	27,333	1.27
17	17,993	17,404	489	467	29.42	6.02	3	2	8,000	10,000	0.44
18	[C]17,762	17,842	[D]585	[D]536	29.50	5.04	7	5	7,000	7,000	0.39
19	[C]10,113	9,719	769	678	44.17	5.75	3	3	8,687	6,088	0.86
20	[C]8,908	8,792	1,028	923	45.03	4.36	...	...	3,500	4,000	0.39
Total	3,355,299	3,270,703	[A]727	[A]678	[A]34.59	[B]4.76	817	569	$790,820	$630,205	[A]0.49

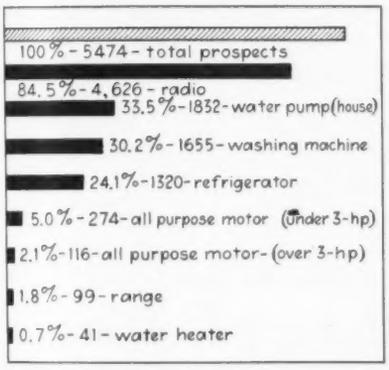
[A]Straight line average. [B]Weighted average. [C]Operate some gas service also. [D]Rent ranges. [E]Rent water heaters. [F]Sell both electric and gas appliances. [G]Electric only.

BUILDING UP THE LOAD

New ideas and practices in selling electrical equipment and service to industrial, commercial and domestic customers

Appliances Desired by Rural Prospects

A study of the major appliances desired by prospects for rural service in Massachusetts revealed that the radio, water pump and washing machine were the most coveted devices. This study, which was part of a survey of rural electrification in Massachusetts conducted by the F.E.R.A. of that state, was based on replies to inquiries as to the appliances prospects would purchase and install during the first



Relative appeal of appliances on Massachusetts farms

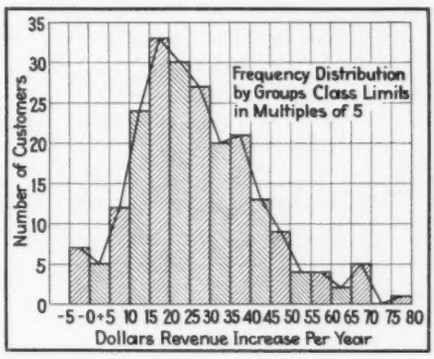
year of service on extensions for which the ratio of capital cost to revenue was 15 to 1.

Of the 5,474 prospects contacted 4,626, or 84.5 per cent, stated that they would purchase radios during the first year, 1,832 expressed a desire for domestic water pumps, while 1,655 desired washing machines. The complete breakdown is shown in the accompanying chart.

•

$27 Yearly From Ranges

Analysis of 217 range installations selected from all districts (except one) of the Central Maine Power Company shows that the average annual revenue derived therefrom is about $27. This study was made to avoid drawing hasty conclusions based on relatively small sections. While the arithmetic average was about $27, nearly 50 per


Number of Customers
Frequency Distribution by Groups Class Limits in Multiples of 5
-5 -0+5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Dollars Revenue Increase Per Year

Revenue increases from adding electric ranges

Based on analysis of 217 customers. Note that 33 produced from $16-$20 more revenue per year; five produced $1-$5; one produced $76-$80, while 155 produced between $11-$40. Taken as a whole, they averaged $27, but 50 per cent produced $25 or less.

cent of the customers produce annual revenues of $25 or less. Attention is called to the fact that no adequate study has been made of the return of short-term customers, although a few are covered in this analysis. The company believes they would not produce one-third the reported average revenue. It is interesting that seven of the customers produced less revenue after installation of a range than before.

In preparing this analysis the consumption before and after installation of the range was employed and the present rate applied to both values to offset the effect of rate reductions. Only customers who had had a range installed for twelve consecutive months and who during that period had added no other major appliance were included.

•

New Light Technique Focuses Merchandise

All pendant-type lighting fixtures were eliminated and modern recessed reflectors used in a large San Francisco market. Customers do not have their eyes attracted to a line of glaring lighting units. They are attracted to the merchandise itself due to the high intensity of light directed upon it. Foot-candle meter readings show from 30 to 55 ft.-candles on the meat counters, from 35 to 60 ft.-candles on the vegetable displays, 65 ft.-candles on the poultry counter and from 20 to 25 ft.-candles in the grocery department.

Lighting in the windows is between 250 and 425 ft.-candles, the entire front of the store being of glass.

For main store lighting 200-watt and 500-watt lamps are used, being spaced on 5-ft. centers. In the windows 500-watt receptacles are used, being lamped with 300-watt globes. There are nineteen of these units in each window and approximately 60 units in the store proper. The total connected lighting load is 25.5 kw., which is many times that of the mar-

Reflectors recessed in the ceiling eliminate glare and focus customers' attention on the goods

kets of similar size and indicative of the load-building value of selling modern lighting for merchandising psychology.

•

Cost of Adding Power Load

What any electric utility can afford to spend to add power load to its system is a matter determined entirely by local conditions. Therefore the accompanying figures of cents paid per dollar of estimated added power revenue are not presented as typical, but simply to show the range of such costs in a group of companies operating in areas where power loads are mostly in consumer-goods production. These companies are in the Middle West group and all their costs for adding power load combine into those shown in the table for the parent company and which, perhaps, may be taken as typical.

The table shows comparisons of estimated annual revenue from new power business added in 1934 with estimated annual revenue from new business budgeted to be added in 1935, both stated in money, in per cent of gross revenue from power sales for the previous year and in cents expended to secure each dollar of new business.

Electric Merchandise Certificate
The Coast Counties Gas and Electric Company
presents you with this Gift Certificate in the amount of
THE SUM OF $2 AND 45 CTS.
which is 50% of your January domestic electric bill. This certificate may be used as cash in the amount hereon specified as full or part payment on any electric appliance or merchandise listed on the reverse side, when purchased from an accredited local dealer.
MR. JOHN DOE
1936 JANUARY ST.
ELECTRIC, CALIF.
TO DEALERS—Only one certificate accepted on any one transaction. All appliances sold under this plan must bear Underwriter's approval tag.
THIS CREDIT IS VOID AFTER FEBRUARY 29, 1936

Reproduction of electrical gift certificate issued by the Coast Counties Gas & Electric Company to stimulate merchandise sales

Gift Certificates Stimulate Sales

An unusual sales stimulant is found in the electrical merchandise certificate plan developed by the Coast Counties Gas & Electric Company, Santa Cruz, Calif. Under the plan all domestic customers of the utility were presented with a gift certificate amounting to 50 per cent of their electrical bill for January. This certificate could be cashed by the customer at any electrical dealer store at its full face value as payment for an electrical appliance. In other words, a customer with a $4 electric bill will be presented with a certificate for $2, the full amount of which he can apply against the purchase of an appliance.

The utility refunds the dealer the amount of the certificates which he has taken in, less 10 per cent. It is expected that a large number of the customers of the company will have taken advantage of this free gift offer during the month of February, the offer terminating on February 29.

•

Ironer Shoes for Drying Blue Prints

By H. R. STEVENSON
Detroit Edison Company,
Detroit, Mich.

In many drafting rooms in any fairly large city there are in use blueprinting machines of an honorable antiquity, but which are yet sturdy and adequate performers even though they lack most of the refinements of more modern designs. The owners of these machines hesitate to junk them and invest in newer models and are usually quite receptive to suggestions for modernizing them.

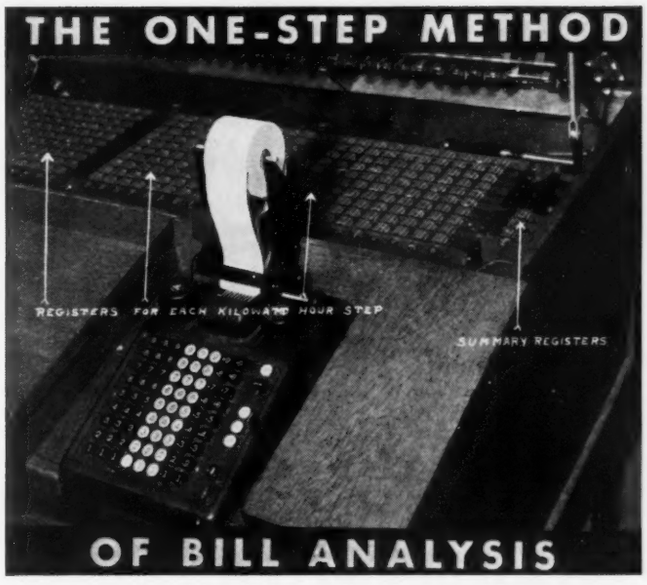
One suggestion that has given new lease of life to several of these veterans in Detroit and has incidentally helped to build utility load is that the old combustion heat dryer be discarded and its place taken by a roll on which is mounted a couple of standard 1½-kw. ironer shoes, end to end to cover the whole width of paper in the machine. The thermostatically controlled shoes both dry and iron the output and they are installed so that they may be lifted back to prevent the paper from being scorched when its travel is stopped.

Table of Added Power Business and What Was Paid for It

Company	1934 Annual Revenue from Added Load, Per Cent of '33 Gross	1934 Annual Revenue from Added Load, In Dollars	1934 Cents Cost/Dollar of Estimated New Revenue	1935 Estimated Revenue from Added Load, Per Cent of '34 Gross	1935 Estimated Revenue from Added Load, In Dollars	1935 Cents Cost/Dollar of Estimated New Revenue
a	14.9	22,460	0	12.4	20,000	2
b	14.8	275,235	11	11.6	185,000	15
c	6.2	57,131	32	9.9	110,000	20
d	7.3	14,546	21	8.8	18,500	22
e	2.2	2,309	0	8.0	11,500	4
f	0	0	0	7.3	1,766	14
g	15.9	40,970	9	7.0	18,000	21
h	18.2	33,965	2	6.9	15,000	3
i	6.3	165,798	4	6.8	180,550	16
j	4.9	3,167	0	6.0	3,600	0
k*	*6.3*	*948,117*	*11*	*5.9*	*878,047*	*17*
l	4.2	71,052	12	5.7	100,000	16
m	5.3	89,779	6	5.2	92,000	12
n	8.7	85,822	14	4.4	43,750	30
o	0.3	1,533	30	4.4	15,000	17
p	5.8	43,086	32	4.3	30,000	45
q	4.6	3,215	7	4.3	3,000	5
r	4.3	5,275	2	4.2	5,000	4
s	3.0	2,039	22	3.3	2,000	24
t	4.0	5,130	4	3.2	4,000	9
u	2.5	9,297	3	2.7	10,000	4
v	0.5	1,933	9	2.3	7,361	16
w	0.8	3,375	1	0.3	1,000	25

*This is the total for all Middle West companies. If each company did as well as the best in 1935, Middle West's added power revenue would be $2,040,000. If all did only as well as the company with the smallest E.A.R. budgeted for 1935, Middle West's added revenue from new power business would be only $40,500.

An Innovation in Utility Rate Studies



R & S Bill Frequency Analyzer: This machine was especially developed for our Public Utility rate service. The kw.-hrs. billed are entered on a standard adding machine keyboard. The adding machine produces a tape of all items and accumulates a consumption total, which serves as a control. At the same time electrically operated accumulating registers build up and summarize totals showing the number of bills occurring for each kw.-hr. step.

THROUGH the use of this new machine, Recording and Statistical Corporation is prepared to relieve you of the entire burden of bill analysis—delivering to you reports the way you want them—promptly and accurately.

Whether you maintain an analysis currently, or undertake a special compilation when rate changes are being considered, this new method has actually *proved* great savings over hand or other machine methods.

You will readily see why this new machine is the practical answer to your bill analysis problems.

From a Feature Article,
Electrical World, February 29, 1936
by
S. MURRAY JONES

"Appreciably lower costs, quicker results and avoidance of staff increases show the superiority of new machine method over prevailing methods of consumption analysis."

Write for reprint of the Electrical World article

Recording & Statistical Corporation

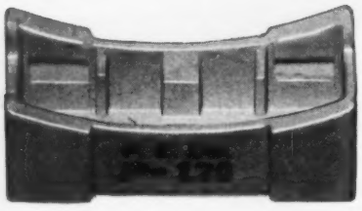
The World's Largest Statistical Service Organization

102 Maiden Lane, New York

BOSTON—PHILADELPHIA—CHICAGO—DETROIT—OKLAHOMA CITY—MONTREAL—TORONTO

THE STAR METER SEAL

MAKES METERS TAMPERPROOF



A simple, inexpensive porcelain cap that seals all type CS meters effectively and permanently—*cannot be removed without completely destroying or badly mutilating it.* Write for sample and details.

We make porcelain for all electrical insulating needs—for decorative purposes.

THERMOLAIN

Heat Resistant Refractory

Thermolain is a porous porcelain of good mechanical strength — an excellent refractory for ranges, heaters, irons, rheostats, immersion heaters, etc., where rapid changes of temperature occur.

LAVOLAIN

for Mechanical Strength

A dense, heat-resistant insulation—recommended for bushings, coils, rods and other parts requiring mechanical strength and for ovens, toasters and other equipment where high dielectric strength at high temperatures is necessary.

We make a number of porcelains for many purposes—can supply the exact material and part you need to give maximum service. Write us.

STAR PORCELAIN CO.
TRENTON, N. J.

Recent Rate Changes

CONNECTICUT LIGHT & POWER COMPANY has reduced electric rates in all classifications effective March 27 in New Britain, Waterbury, Westport and adjacent towns. Number one rate for domestic consumption will be reduced from 4 to 3½ cents per kilowatt-hour for all energy in excess of 20 kw.-hr. per month. Number two domestic rate will be 3 cents per kilowatt-hour for the first 100 kw.-hr. and 2½ cents for all energy in excess of 100. The present rate is 3 cents for all energy in this bracket. Under this classification when service is used for electric cooking the charge will be 2 cents for all energy in excess of 100 kw.-hr.

MONTANA PUBLIC SERVICE COMMISSION has continued until March 19 its hearing on its order to show cause why the Mountain States Power Company should not lower electric rates in the Flathead Valley.

LOUISVILLE GAS & ELECTRIC COMPANY'S agreement with the city on current electric and gas rates fixed in 1934 continued in effect after March 1, the agreed expiration date. The continuance was agreed upon because a conference to readjust the rates cannot be held until the week of March 16.

NEW YORK STATE ELECTRIC & GAS CORPORATION has filed a revision of electric rates with the Public Service Commission which are to become effective March 12 in the Ithaca district of the company. The revised rates are estimated to save consumers about $43,000 annually. The residential rate is reduced by changes in block lengths and unit charges. Water heating service is offered at 1½ cents per kilowatt-hour for use in excess of 150 kw.-hr. monthly. No residential consumers will be increased, and it is estimated that they will save approximately $23,000 a year. Reductions in the rates for general commercial service are estimated to save consumers $20,000 annually.

SOUTH CAROLINA PUBLIC SERVICE COMMISSION has secured reductions from two electric power companies, one to affect the residential and commercial customers of the South Carolina Utilities Company of Conway and the other the ice plant operators of the Carolina Power & Light Company of Raleigh, N. C. The total reduction to be put in effect by the Conway utility amounts to $6,319 annually, of which about $4,000 is for the benefit of residential consumers and $2,321 commercial consumers. The new rate for ice plants will benefit all plants of 25 hp. or over served by the Raleigh utility in South Carolina.

OHIO PUBLIC SERVICE COMPANY has reduced light and power rates in Mansfield, Massillon, Ashland and surrounding communities in addition to the rate cut recently announced for Alliance (ELECTRICAL WORLD, February 29, page 13). The new rates include abolition of a $1 per month service charge and sliding reductions which will mean a saving of $91,000 for Mansfield alone. The saving at Massillon will be $52,666 annually and that at Alliance $21,800, as previously announced. The rates affect residential service, commercial lighting and small factories.

MADISON GAS & ELECTRIC COMPANY'S electric rates were recommended for a slash of $28,000 to the Wisconsin Public Service Commission by its rates and research department. A restoration of pay cuts for the utility's employees was also recommended. The reductions, which the department proposed, are $6,639 for domestic consumers using more than 150 kw.-hr., $18,747 for large commercial lighting and power customers and $2,620 for small commercial lighting and power customers. The reduction in rates will leave the company sufficient margin to restore the pay cuts, the rates department maintained.

WALWORTH LIGHT & POWER COMPANY, which serves the towns of Walworth and Macedon in Wayne County, has filed with the New York Public Service Commission a rural extension plan derived from that of the Rochester Gas & Electric Company which serves adjacent territory. The new rural plan, which becomes effective March 15, is $1 for the first 500 ft. or less of extension per applicant, 20 cents per 100 ft. or fraction thereof for the next 1,000 ft. per applicant, 40 cents per 100 ft. or fraction thereof for the next 1,000 ft. per applicant and 50 cents per 100 ft. or fraction thereof for all over 2,300 ft. per applicant.

MINEVILLE LIGHT, HEAT & POWER COMPANY, which serves the village and town of Mineville in Essex County, is under investigation by the New York Public Service Commission. Electric rates, charges and practices will be probed as well as the price paid by the company for electricity purchased from the Witherbee-Sherman Corporation, an affiliated company. Revisions of the rate schedule were informally submitted by the company in 1934 and were rejected for the reason that about 64 per cent of the residential customers would be increased under the proposed rates. Another informal proposal would have increased the rates to commercial users.

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Municipal Plants

CENTRAL CITY, IOWA—By a vote of 155 in favor and only 18 against, citizens recently granted a 25-year renewal of the franchise of the Iowa Electric Light & Power Company.

LA PLATA, MO.—Missouri Power & Light Company has asked the District of Columbia Supreme Court for an injunction restraining P.W.A. from carrying out a $100,000 loan and grant agreement for the construction of a municipal power plant. P.W.A. was ordered to show cause why the injunction should not be granted.

THAYER, MO.—By a vote of 503 for and 162 against citizens have approved a $40,000 bond issue for a municipal light and power plant. P.W.A. has approved a $32,738 grant for the project. Total estimated cost $72,750.

PAWTUCKET, R. I.—A bill has been introduced in the State Legislature to permit the city to issue bonds for the purpose of financing the construction of a municipal power plant.

FALLS CITY, NEB.—Effective March 1, reductions in electric rates ranging from 25 to 33⅓ per cent were made by City Council. Officials estimate the cut will save consumers $20,000 a year. Under the new schedule residential charges will be 4 cents per kilowatt-hour, compared to 6 cents previously.

BURLINGTON, KAN.—Because P.W.A. regulations covering local construction projects were not complied with in building a municipal power plant, a federal grant of $41,300 to cover 30 per cent of the cost of labor and materials from the original public works construction fund has been revoked. This action was taken in accordance with the usual P.W.A. policy in such cases.

KNOXVILLE, TENN.—A temporary restraining order to prevent P.W.A. from allocating $2,600,000 to the city for construction of an electric distribution system was granted last week to the Tennessee Public Service Company by Justice F. Dickinson Letts in the District of Columbia Supreme Court. The money was proposed for a transmission line to one of the T.V.A. generating plants.

PAINT RESEARCH HELPS CONVERT

A GREAT deal more is known today about the relation of paint to light, and to the visual welfare of workers—thanks to the "Better Light — Better Sight" researches. Pittsburgh Plate Glass Co., co-operating with the electrical industry in this movement, has made an intensive study of paint as a factor in lighting, and its relation to slow production, lost time, labor turnover, accident compensation, etc.

The new maintenance finishes that resulted are known as *Glorified Light Products*. The booklet, "Glorified Light," describes how they are designed to convert *raw* light economically into *useful* light through proper diffusion and reflection.

Naturally, reduced maintenance cost was also rated of prime importance in the development of these finishes. You'll discover, when you read "Glorified Light," how thoroughly each of the three finishing systems is designed to resist the type of deterioration it meets in specific types of plants.

No executive concerned with production or maintenance should be without a copy of this book. Send the coupon for your copy — and bring your file of information about modern maintenance methods up to date.

***LISTEN TO** the Music You Love, superbly rendered by the Pittsburgh Symphony Orchestra and distinguished guest artists, every Thursday at 8 P. M. Eastern Standard Time, over N. B. C. Blue Network and associated stations.*

3 FINISHING SYSTEMS

The three divisions of *Glorified Light Products*, designed to meet varying plant requirements, are as follows:

THE SNOLITE SYSTEM— a line of superior whites for all normal interior exposures. Flat, Satin, Low Eggshell, Standard Eggshell, Semi-Gloss, Gloss. Tints available in Satin and Semi-Gloss.

THE SNOTEX SYSTEM— for all abnormal interior exposures except where fungus may be expected. The highest attainable resistance to discoloration in the presence of humidity, fumes, gases, heat or unusual absence of daylight.

THE FUNGUSIDE SYSTEM— for use where fungus exists or may be expected. Of especial importance to bakers, brewers, distillers, cheese manufacturers, dairymen, packers and others who must wage a constant battle against bacteria, mold or other types of fungus.

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MEN OF THE INDUSTRY

Francis Hodgkinson Retires from Westinghouse Service

Retirement of Francis Hodgkinson, one of the outstanding figures of the engineering profession, from the employ of the Westinghouse Electric & Manufacturing Company was marked recently with a dinner given in his honor by the employees of the company's South Philadelphia Works at the Racquet Club in Philadelphia. One hundred and sixty persons attended. Co-worker with Sir Charles Parsons and later right-hand man of George Westinghouse in the development of the steam turbine in the United States, Mr. Hodgkinson leaves Westinghouse after 42 years of outstanding service to that company and to the engineering profession.

Born in London, England, in 1867, Mr. Hodgkinson became associated in 1885 with Sir Charles Parsons in the early development of the reaction steam turbine. In 1896, when George Westinghouse negotiated a license agreement with Sir Charles Parsons, Mr. Hodgkinson at the latter's recommendation came to the Westinghouse Machine Company to initiate the designing and construction of steam turbines. He was responsible for steam turbine construction until 1916, when he was made chief engineer, responsible for all steam power apparatus of the Westinghouse Electric & Manufacturing Company. In 1926 he was made consulting mechanical engineer for the Westinghouse company, the position he has held until the time of his retirement.

Among the honors which have been bestowed upon Mr. Hodgkinson are the Elliott Cresson gold medal of the Franklin Institute of Philadelphia and the Willans gold medal of the Institution of Mechanical Engineers and the Institution of Electrical Engineers of Great Britain. He is a member of the American Society of Mechanical Engineers, Engineers' Society of Western Pennsylvania and the Institute of Mechanical Engineers of Great Britain.

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▶ STEPHEN W. SMITH, chief engineer examiner for the P.W.A. in Massachusetts, has been appointed project engineer for the Loup River federal power district, Columbus, Neb. From 1913 to 1923 he was employed on various hydroelectric undertakings in northern New England, and for ten years afterward was connected with the Stone & Webster Engineering Corporation, notably on the Rock Island project on the Columbia River. He has been succeeded at Boston by Walter M. Stone, who has been assistant chief engineer examiner since 1933 and who was previously associated with Stone & Webster and J. R. Worcester & Company, Boston.

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O. H. Hutchings Resigns From General Managership

O. H. Hutchings has resigned as general manager of the Dayton Power & Light Company and Frank M. Tait, president of the company, has been elected as general manager.

Mr. Hutchings continues with the organization as a director and as vice-president. At the January meeting of the board of directors he was requested by the board and agreed to continue as engineer having complete charge of all the major engineering work now in progress.

O. H. Hutchings

This year, Mr. Hutchings completed his 44th year of continuous active service with the electric light and power industry, and he has been associated actively with the Dayton Power & Light Company during that time. In keeping with the continuous expansion and growth of the Dayton Power & Light Company, Mr. Hutchings has been largely responsible for the rapid development of the company.

Mr. Hutchings is widely and favorably known throughout the electric industry as an aggressive public utility executive and operator. On the occasion of his 44th anniversary, many friends and business colleagues, both in Dayton and different sections of the country, offered congratulations and good wishes.

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▶ RT. HON. LORD HIRST of Witton, chairman and joint managing director of the General Electric Company, Ltd., has accepted nomination as president of the Federation of British Industries for the 1936 session. Lord Hirst is an outstanding figure in the electrical engineering industry in Great Britain, and at 72 is still one of the most active executives in British industry.

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Birmingham Electric Names New Sales Managers

Announcement has been made of several changes in the sales personnel of the Birmingham Electric Company under Holland E. Cox, vice-president, in charge of sales.

D. S. Richard has been made dealer sales manager; W. W. McLaren, commercial sales manager; W. P. McCutcheon, industrial sales manager and Barney DeRamus, residential sales manager.

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▶ PROF. WESLEY B. HALL, formerly a member of Yale University faculty, has been appointed head of the department of electrical engineering at the Rhode Island State College.

▶ J. C. DAMON, formerly chief engineer of the Wisconsin Public Service Commission, has been appointed to the position of public utilities consultant engineer of the Securities and Exchange Commission in Washington, D. C.

▶ J. D. WRIGHT and KARL H. RUNKLE have been appointed assistant managers of the General Electric Company's industrial department. Mr. Wright was formerly assistant head of the industrial department's engineering staff and Mr. Runkle was manager of sales of the department's mining and steel mill section.

▶ ROBERT E. DILLON, since 1925 superintendent of the generating department of the Boston Edison Company, received congratulations recently upon the completion of a quarter-century of service with that utility. On the anniversary of entering the company he was presented with a watch and traveling bag by departmental employees. In addition to his work at Boston Mr. Dillon has figured actively in the prime movers committee of the Edison Electric Institute and in power test code undertakings of the A.S.M.E.

▶ HARRY RESTOFSKI has been appointed sales promotion manager of the West Penn Power Company, Pittsburgh. Mr. Restofski brings to his new position a wealth of practical experience gained in his twenty-two years with the company in various capacities. Beginning in the meter laboratory at Connellsville he was later transferred to the substation department, and in 1917 became assistant to the superintendent of substations. Four years later he was transferred to Pittsburgh as assistant to the vice-president. Having been assistant general manager of West Penn Appliance Company over

A Wealth of Experience Back of
INTERNATIONAL HARVESTER POWER

Above: An International Harvester T-20 TracTracTor working on an electrification project. Six of these crawler tractors were used on this job to string wire and do other work along the right-of-way.

●

The International Harvester line of industrial power (gasoline and Diesel) includes TracTracTors, wheel-type tractors, stationary power units from 12 h.p. to 115 h.p., and 1½ to 5 h.p. engines for light-duty service.

INTERNATIONAL HARVESTER Industrial Power — product of the world's largest tractor builder—reflects the valuable experience this organization has gained through its long and close association with the public-utility field and other users of heavy-duty power.

Take the TracTracTor for example. In this tractor, International Harvester put onto the market the *most accessible, most easily serviced* crawler. Steering clutches and brakes can be inspected, adjusted, or replaced through rear cover plates without disturbing the tracks, track frames, or driving sprockets. And working parts are thoroughly protected against entrance of abrasive materials by the effective use of self-adjusting triple dust seals.

Your best investment in industrial power is International Harvester. The nearest industrial dealer or Company-owned branch is ready to serve you well. See them about a demonstration.

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a period of eight years, starting in 1926, Mr. Restofski is no stranger in the field of selling. Just before taking over his present duties he served as personnel director.

▶ E. A. CLEVELAND of Vancouver, B. C., has been elected president of the Engineering Institute of Canada.

▶ D. H. O'BRIEN, general merchandising manager of the Graybar Electric Company with headquarters in New York, completes his twentieth year of continuous service with the company this month.

▶ HARRY E. CLIFFORD, dean of the Harvard Graduate School of Engineering, has resigned, effective September 1. Dean Clifford also resigned from the Gordon McKay professorship of electrical engineering. He becomes professor emeritus.

▶ E. F. MCNAUGHTON has been appointed director of research of the California Railroad Commission to succeed Walter W. Cooper. A graduate of the University of California, Mr. McNaughton has been employed as an assistant engineer on the commission since 1924.

▶ J. B. MACNEILL, formerly general manager of distributing engineering, Westinghouse Electric & Manufacturing Company, who has been at East Pittsburgh, Pa., and Boston, Mass., has returned to East Pittsburgh as manager of switchgear engineering. Mr. MacNeill is prominently identified with committee work of the American Institute of Electrical Engineers.

NEIL CURRIE, JR., for the last six years manager of the General Electric Company's Philadelphia works, was made manager of its Fort Wayne works, effective February 1. Mr. Currie succeeds WALTER S. GOLL, who, although retiring as manager after 38 years of service, will continue with the company and will be available for special assignments. R. V. GOOD, previously assistant manager at Philadelphia, was appointed manager to succeed Mr. Currie.

▶ W. E. DIVEN, for six years district manager at Smith Center for the Kansas Power Company, has been promoted to the position of general sales manager and assistant division manager with headquarters at Concordia. He will assume his new duties about March 15.

▶ WILLIAM E. SCHUBERT has been appointed general manager of the Wisconsin Michigan Power Company, Appleton, Wis., and R. E. Moody, vice-president and formerly general manager, has been appointed executive vice-president of the company, according to an announcement made by S. B. Way, president. Mr. Schubert began his public utility service in 1914 with the Milwaukee Electric Railway & Light Company and Mr. Moody joined the Milwaukee utility in 1913.

H. K. Barrows Heads Civil Engineers of Boston

Harold K. Barrows, professor of hydraulic engineering at the Massachusetts Institute of Technology, consulting engineer at Boston, Mass., and widely known in the hydro-electric and water supply fields, was elected president of the Boston Society of Civil Engineers on March 11. Professor Barrows was graduated from the above institute in 1895 and his early career included connection with many municipal and state projects, three years of service as district engineer of the water resources branch of the U. S. Geological Survey for New England and two years for New York State. He was made associate professor in 1909 and full professor in 1921,

H. K. Barrows

and has charge of the hydro-electric option in the civil engineering course at "Technology."

In private practice he has appeared in numerous court proceedings involving water and water power issues. He is a member of many professional societies, is a fellow of the American Academy of Arts and Sciences and is the author of "Water Power Engineering" (McGraw-Hill Book Company), as well as of many professional papers on hydraulic, power and water supply matters.

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▶ J. DUDLEY MARKS has been elected manager of the Firetox Company, Attleboro, Mass.

▶ MELVIN GIERSBACH left recently for Shanghai, China, to assume his new position as export representative of the Four Wheel Drive Auto Company. Mr. Giersbach entered the service of the FWD Company more than ten years ago.

▶ HARRY E. WARD, president of the Irving Trust Company, has been elected a director of the American Gas & Electric Company.

▶ H. V. PUTMAN, manager of the transformer engineering department of the Westinghouse Electric & Manufacturing Company at Sharon, Pa., since 1931, is now manager of the switchgear management unit of the company at East Pittsburgh, Pa. Mr. Putman is active in the affairs of the American Institute of Electrical Engineers.

▶ DR. HERBERT VICKERS, head of the department of mechanical engineering, will leave the University of British Columbia, Vancouver, B. C., at the end of the present term to accept a position offered him with a leading English firm engaged in technical electrical work. Dr. Vickers is a fellow of the American Institute of Electrical Engineers, the American Society for the Advancement of Science and the Physical Society of London.

▶ SIR WILLIAM RAY has resigned as executive chairman of the British Electrical Development Association.

▶ EDWARD AVEGNO has been elected president of the Electrical Association of New Orleans, to succeed Walter A. Northington.

▶ FRANKLIN H. NICKERSON, vice-president of the Consolidated Gas Company of New York, has been elected a member of the board of trustees.

▶ RAY MRACHEK of Rochester, Minn., was elected president of the Minnesota Electrical Association at the recent annual convention.

▶ E. ROBIN LITTLE was elected assistant secretary of the Niagara Hudson Power Corporation at a meeting of the board of directors held recently to succeed Harold S. Sutton. Mr. Sutton and W. H. Versfelt resigned as assistant secretaries. Mr. Little has been associated with the Niagara Hudson Power Corporation since 1930.

▶ R. J. ECKSTEIN has been appointed manager of the Cleveland office of Cutler-Hammer, Inc., of Milwaukee. Mr. Eckstein became associated with Cutler-Hammer 25 years ago. A major portion of his career has been devoted to the application of electric control to motors in every phase of industry.

▶ THOMAS B. MCGREGOR of Frankfort, former judge of Franklin Circuit Court, has been appointed by Gov. A. B. Chandler a member of the Kentucky Public Service Commission.

▶ MOREY F. ORRELL has been appointed supervisor of wires and street lighting for the city of Worcester, in addition to his present duties as superintendent of fire alarm telegraph. He will succeed Henry A. Knight, who will shortly retire after about 50 years of service in which he attained a distinguished reputation as an authority on electrical fire hazards.

▶ ROBERT P. SLOAN has been appointed a member of the British Central Electricity Board to succeed Sir James Devonshire, whose term of appointment has expired. In order to maintain an independent attitude as a member of the

board, Mr. Sloan is resigning in the course of the next three months his membership on the boards of the Greater London and Counties Trust, Ltd., Edmundson's Electricity Corporation, Ltd., and their various associated enterprises.

OBITUARY

▶ CHARLES B. WARREN, chairman of the municipal lighting board at Westfield, Mass., died at his home in that place March 1, following a heart attack.

▶ KENNETH L. CURTIS, consulting engineer and formerly teacher of electrical engineering at Stanford University, died recently of pneumonia at his home in New York at the age of 57. Mr. Curtis was at one time chief engineer of the Albert & J. M. Anderson Manufacturing Company of Boston and was for a time connected with the General Electric Company at Schenectady.

▶ PROF. WILLIAM ANDERSON, head of the electrical engineering department at Rhode Island State College since 1918, died at his home in Kingston, R. I., on December 27, after several weeks' illness. He was born in Chanute, Kan., 62 years ago and was educated at Kansas State College and Cornell University. For 21 years he taught engineering at his alma mater and at the Michigan College of Mines.

▶ JOHN K. HIMES, veteran employee of the Dayton Power & Light Company, Dayton, Ohio, died January 19, following an illness of one year, at the age of 51 years. Mr. Himes earned a series of promotions which found him at various times an engineer in the distribution department, superintendent of transmission and distribution, and in 1932 supervisor of transmission and distribution engineering. He was active in the old Ohio Electric Light Association and served on various committees of the old National Electric Light Association.

▶ J. F. H. WYSE, general manager of the Ontario Safety League and the Canadian National Safety League, died December 28 while on a visit to Worcester, Ohio. Mr. Wyse obtained his early experience in the engineering field with the Sprague Electric Company in New York, with which he became associated in 1887. Later he was employed by the General Electric Company. His activities in this connection took him to Dallas, Tex.; Steubenville, Ohio; British Columbia and various parts of Canada. Then he was appointed general manager of the electric lighting plant and street railway system of Brantford, Ont. Subsequently he established a consulting engineering practice in Toronto.

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taking into account the financial status of the purveyor.

STERLING HIGH DUTY INTERNAL COMBUSTION ENGINES

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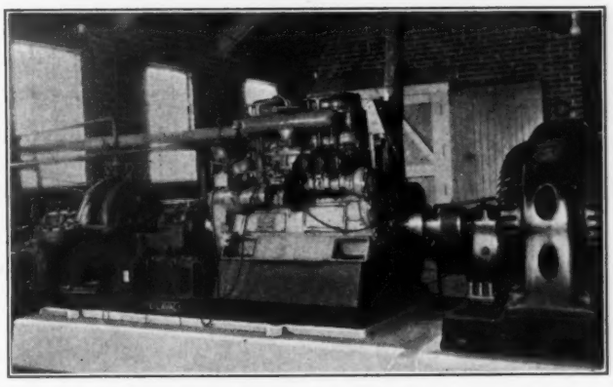

For protection against fire, the Union Power Co., Stettler, Alberta, employs a 100 H.P. GRC-4 cylinder Sterling engine to drive a 750 U.S.G.P.M. DeLaval fire pump at 1200 R.P.M.

When active products (motion machinery) are offered you at distress prices, consider the possibility of inability to obtain service parts later.

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Put it to your most severe test

Your varnished cambric tape is probably bought for a specific service. But whether you concentrate on a few specifications above the others or seek a *combination of all qualities*, Empire Varnished Tape or Cloth will meet your needs.

For power companies and electrical manufacturers, this tape has been especially successful in meeting a wide variety of exacting specifications. These include dielectric strength, tensile breaking strength, elongation, pliability, finish, uniformity, resistance to age, and resistance to the severe conditions encountered in making joints and splices.

So, if your own specifications are particularly exacting, send for a stock sample of Empire Varnished Tape or Cloth. Subject it to your most severe tests. We are confident the results will justify our first statement—this Varnished Tape has "Everything". Available in yellow or black, straight or seamless bias cut. In tape form or in full width materials.

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Chicago Starts Network in Loop

[*Continued from page 41*]

company's systems of generating units and transmission lines (designated as the "red" and "blue" systems), which normally are separated at both generating stations and substation buses. In each of the two substations one network feeder is connected to a bus supplied by the "blue" system and one to a bus supplied by the "red" system. The feeders supplying the street network will also supply existing spot networks in large buildings in adjacent territory.

The network is designed for self-clearing of secondary faults, no fuses being used except those in the network protectors. All service taps are connected directly to the secondary mains, without junction boxes or similar equipment. Two-, three- and four-wire services will be used, in accordance with the size of the load to be served. Transformers and secondary mains are of adequate size to give sufficient capacity and satisfactory regulation with two primary feeders out of service. This relatively high reserve ratio recognizes the need for superior service in this high-load-density territory and also the fact that during the development period at least one primary feeder will be out of service for extension much of the time.

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Nebraska Utilities Cut Accidents 95 per Cent

Accidents have been reduced 95 per cent by Nebraska utilities in the last twelve years, Roy Page, Nebraska Power Company vice-president, told the ninth annual safety conference of the state electrical association in Omaha recently. The Iowa-Nebraska Light & Power Company of Lincoln was awarded the 1935 trophy on a record of 1,676,127 man-hours without a single loss-of-time accident.

•

Tax on Municipal Plants Rests With Circuit Court

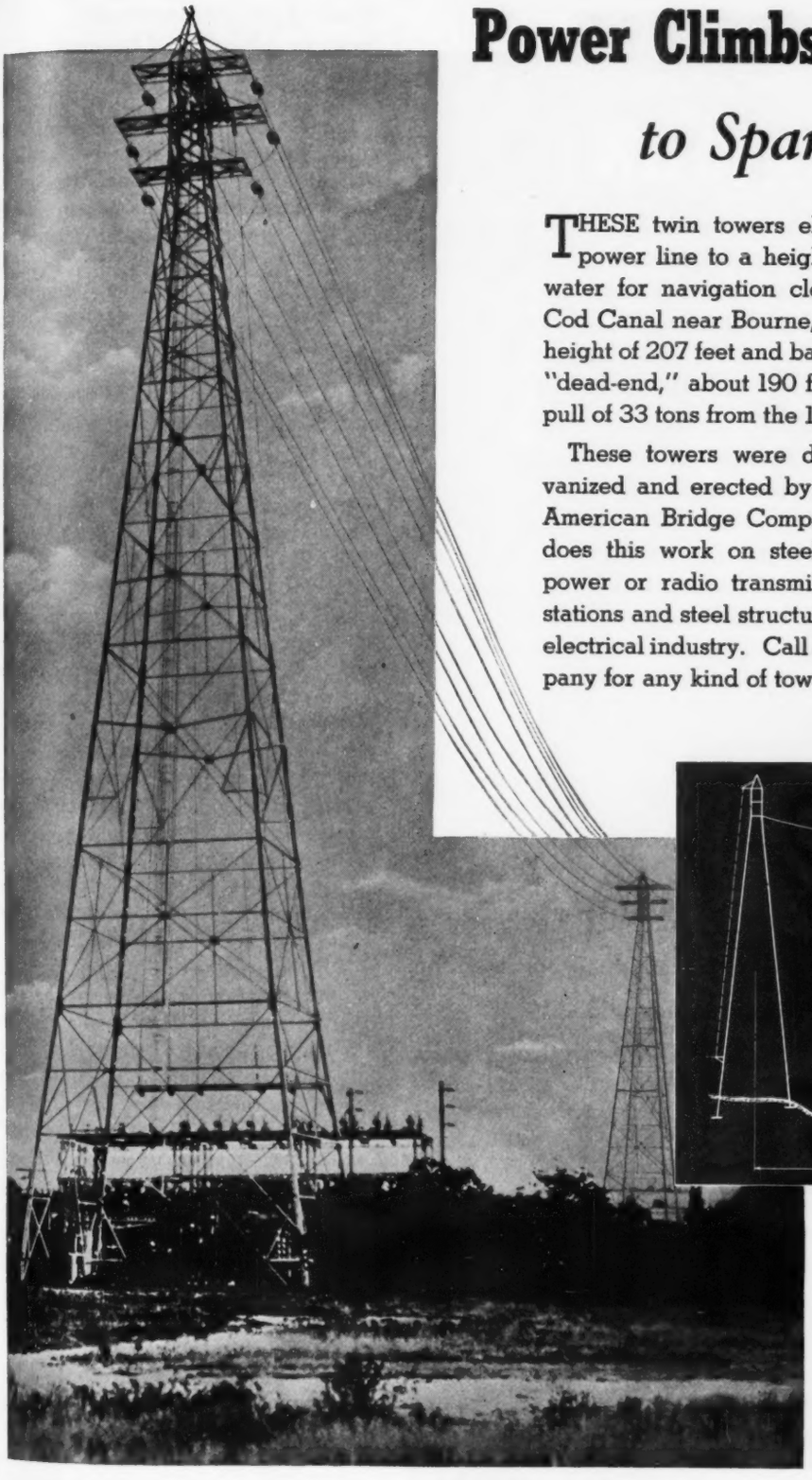
Whether the state of Michigan has a right to collect a tax on the sales of municipal power plants is up to Judge Leland W. Carr, who has reserved decision in the suit brought by three cities —Wyandotte, Lowell, Lansing. Counsel for the municipalities contended that there is no state law permitting a levy on the products of a city-owned utility plant.

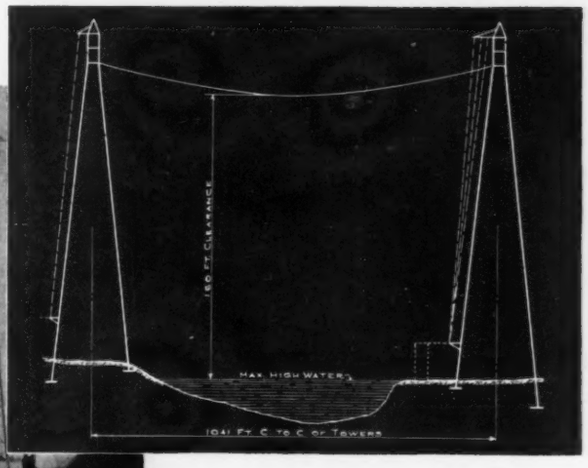
Power Climbs ABC Towers

to Span Canal

THESE twin towers elevate the double circuit power line to a height of 160 feet above high water for navigation clearance across the Cape Cod Canal near Bourne, Mass. Each tower has a height of 207 feet and base spread of 45 feet. They "dead-end," about 190 feet above ground level, a pull of 33 tons from the 1000 foot line span.

These towers were designed, fabricated, galvanized and erected by the tower department of American Bridge Company, a department which does this work on steel towers of all types for power or radio transmission, together with substations and steel structures for all branches of the electrical industry. Call on American Bridge Company for any kind of tower work.





(Above)—Diagram shows navigation clearances provided by power line.

. . .

(Left)—Cape Cod Canal Crossing Towers near Bourne, Mass., built for the Cape & Vineyard Electric Company. Power Line elevated above the canal as future work on the channel made the laying of cables impractical.

AMERICAN BRIDGE COMPANY
General Offices: Frick Building · Pittsburgh, Pa.

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Duluth Minneapolis New York Philadelphia St. Louis

Pacific Coast Distributors: Columbia Steel Co., San Francisco
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UNITED STATES STEEL

They must improve

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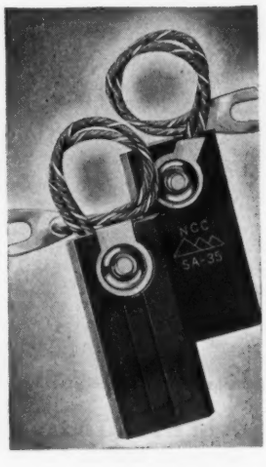
"YOU CAN SEE THEY'RE BETTER"

● Judgment of brush performance on commutating equipment is based on several factors, but none more important than commutation. A brush, to prove superiority, must improve commutation.

The growing popularity of the "SA" Series of electro-graphitic brushes is convincing evidence that they DO improve commutation.



The grades of this series are graduated in performance characteristics. This permits selection of the grade which will provide good all-round performance, as well as good commutation.

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An "SA" Series Grade is not "just another brush." It is the product of a carefully planned program of research and engineering development.

There is a National Pyramid Brush for every class of service.

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Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices: New York Pittsburgh Chicago San Francisco

What Type Supervisory System Shall Be Chosen?

[*Continued from page 43*]

Larger code systems can select any point in about three seconds. Indication of an automatic operation of a single substation unit is also received in about three seconds, but since the equipment must reset to its zero position before another automatic operation can be indicated the average time is approximately four seconds per unit when several have operated automatically. When operated with carrier current about one second is added to the time of selection and to the time of indication of an automatic operation, depending upon the number of stations on the system.

The small code system of one to five points takes about one second for a selection. When all five units have operated automatically the average time per unit for indicating an automatic operation is approximately two seconds. When used with carrier current less than one second is added.

In large stations, where the devices which can operate automatically greatly outnumber the non-automatic, the indicating of such automatic operations in the shortest possible time is paramount, and a synchronous system is the most suitable.

Where speed of selection is more important the choice between the two types of systems will depend upon the number of control and indication points required. By assigning the points on the four-wire synchronous system to devices in the order of their importance one can, in the majority of installations, obtain a selection time equal to or less than that of the code system for these devices. If the number of important devices is such that grouping is neither possible nor practical, then a code system should be applied.

Regarding protective features, practically all the larger systems discussed herein incorporate means for station check and line wire protection. An audible alarm and visual indication is given in case of open or shorted line wires. In the large code systems a means is provided by which the dispatcher can cause the equipment to check all points automatically. Because of its operating principle the synchronous system is unique in that the entire station is checked whenever a selection is performed or automatic operations occur.

When you're scratching your head over . . . .

JUST remember that it has been our pleasure . . . to assist many electrical manufacturers in planning the most intelligent use of silicon steel sheets. Naturally no one grade of sheet fits all applications. Therefore, we manufacture:—

American Transformer and Radio Sheets in several grades for transformers and certain types of high efficiency motors and generators.

American Dynamo and American Motor grades are well suited for generators, motors and some transformer designs.

American U. S. Electrical is standard for the general run of motors and is supplemented by:—

American Armature, a lower grade much used in fractional horse power equipment where inductions are higher than average.

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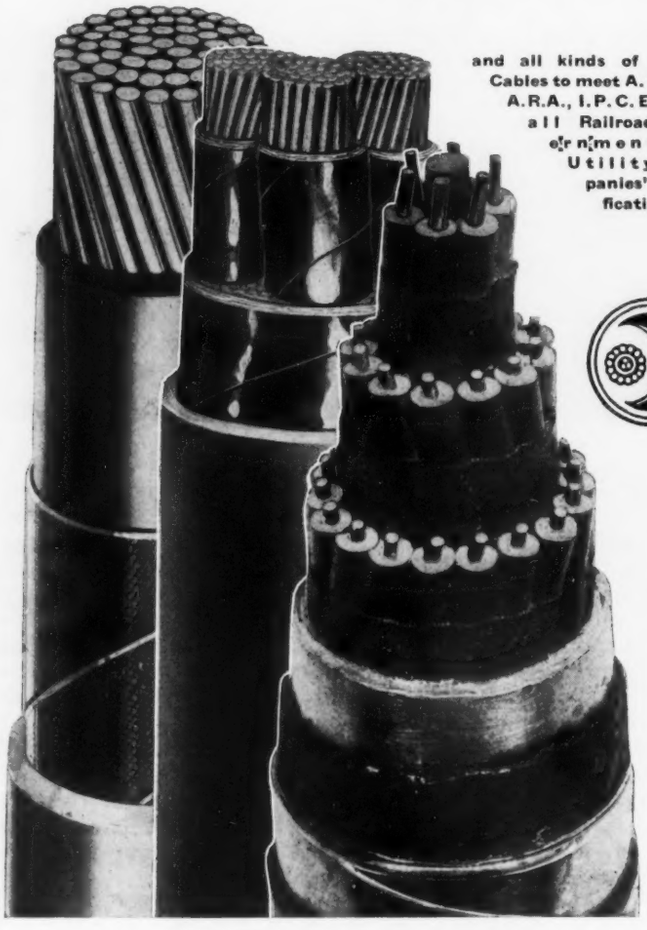
All types of Building Wire

and all kinds of Special Cables to meet A. S. T. M., A.R.A., I.P.C.E.A., and all Railroad, Government and Utility Companies' specifications.



CRESCENT
INSULATED WIRE & CABLE CO. INC.
TRENTON, NEW JERSEY

Rate Results Analyzed on Simplified Basis

[*Continued from page 45*]

The study outlined in this paper has included twelve analyses of both electric and gas utilities which have from several thousand up to four or five hundred thousand residence customers. Size of the utility as gaged by the number of customers apparently has little to do with the straightness of the curve of cumulative per cent blockings, provided the residence rate is effective for the entire range of consumption. If there are optional rates covering the higher brackets of consumption the blocking of either the general rate or the optional rate by itself may not follow the probability law, because only a part of the complete cross-section of the consumption is represented. Also, where there are unusual saturations of electric ranges and water heaters served under a single rate with other residence uses the probability curve may not give satisfactory results. Such situations have not been available for study.

In conclusion, the results of the probability method of studying consumption analyses of residence customers may be summarized as follows:

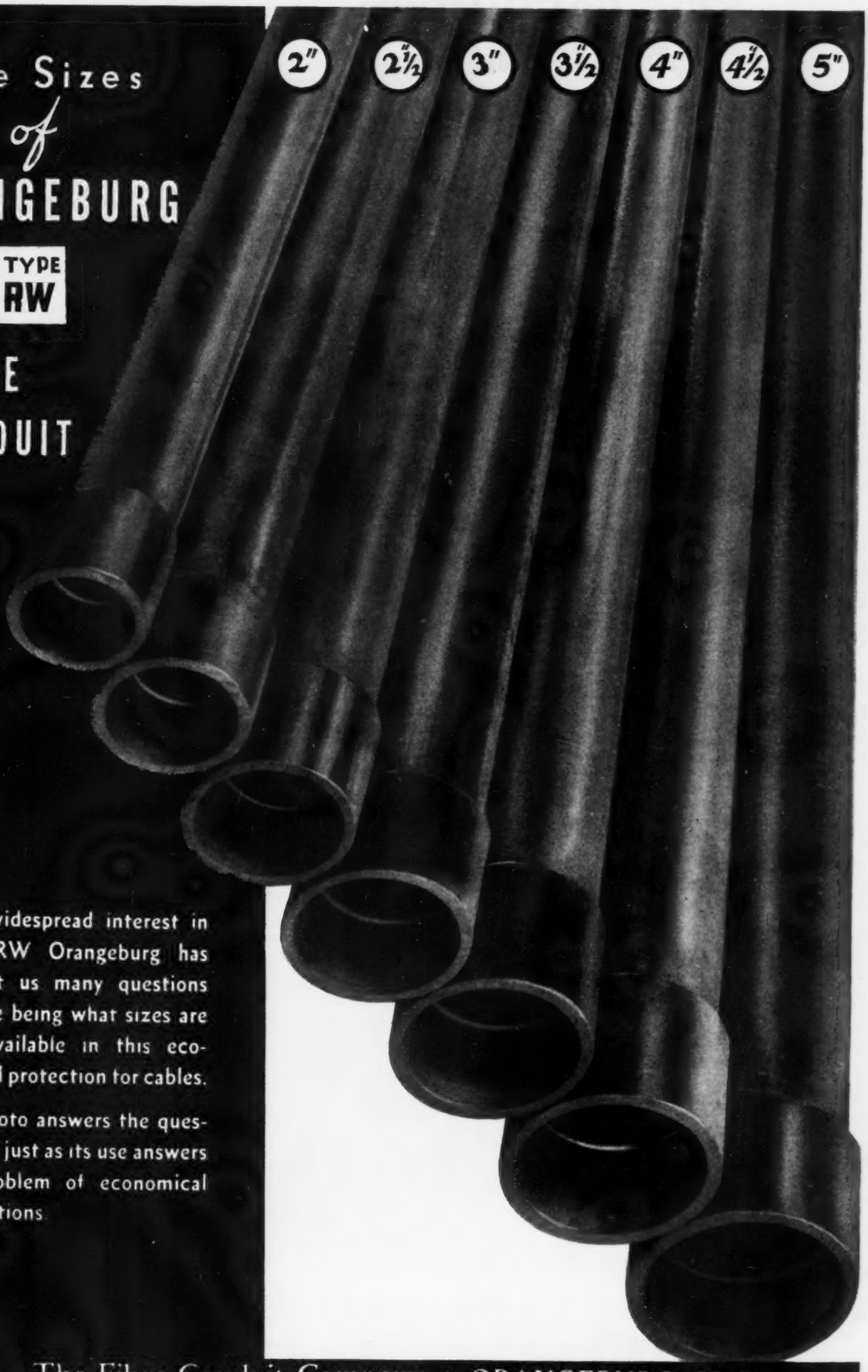
1. Consumption analyses follow in general the law of probability, both as to bills and kilowatt-hours.
2. The blocking of the consumption analysis—i.e., the first 10 kw.-hr., the next 10 kw.-hr., etc.—also follows the law of probability.
3. Since the curves of cumulative per cent of total kilowatt-hours vs. kilowatt-hour blocks are smooth curves, with little or no deviation from a straight line, it is practicable to plot an estimated curve from actual data giving values for at least three or more points of the actual curve.
4. The data required for the construction of the estimated curve are:
   (a) Number of minimum bills and kilowatt-hours in these bills.
   (b) The number of kilowatt-hours billed at the several price steps of the rate.
   (c) The number of bills in excess of 100 kw.-hr. per month and the number of kilowatt-hours in these bills.
   (d) The total number of bills and kilowatt-hours under the rate.
5. The accuracy of the estimated curve appears to be satisfactory, and in general within the accuracy of the usual analysis.
6. The probability curve method is the most convenient way of expressing an analysis.
7. The probability curve method is applicable to analyses of residence gas consumption as well as residence electric consumption.

•

New Line in Operation

Kentucky Utilities Company recently placed in operation its new $300,000 transmission line from Somerset to Williamsburg.

The Sizes of ORANGEBURG TYPE RW FIBRE CONDUIT



The widespread interest in Type RW Orangeburg has brought us many questions . . . one being what sizes are now available in this economical protection for cables.

The photo answers the question . . . just as its use answers the problem of economical installations.

The Fibre Conduit Company • ORANGEBURG, N. Y.

Sales Agents: GENERAL ELECTRIC SUPPLY CORP. ● GRAYBAR ELECTRIC CO.

NEW EQUIPMENT AVAILABLE

Optical Pyrometer

Rapid temperature determination of minute spots, fast-moving objects or small streams are made with this triple-range optical pyrometer. Temperature is determined by rotating a graduated optical absorption wedge to change the apparent brightness of the hot object under measurement, until a small luminous test mark, in the field of vision, disappears. A small ordinary battery with ammeter and adjusting rheostat are supplied in the circuit with a calibrated lamp to illuminate the small comparison test mark to maintain its intensity or brightness constant.

"Pyro Optical" pyrometer; range, 1,400 to 2,200 deg., 1,800 to 3,400 deg. and 2,200 to 3,700 deg. F.; weight, 3 lb. **Pyromotor Instrument Co.**, New York City.

•

Dimmer Panel

This new double template theater illumination control panel permits any number of desired combinations of lighting intensities for each of the stage-lighting circuits to be set up during a rehearsal on special templates or program plates and run off by scenes or acts as the performance pro-

Cutler-Hammer, Inc., Milwaukee, Wis.

gresses. The templates are set up on the duplicate boards of a control desk (shown) and used alternately. A fader is used to fade from the lighting schedule set upon board 1 to that on board 2. Position of the stops on each template determine the position of corresponding potentiometers for each circuit controlled.

•

New Welding Electrode

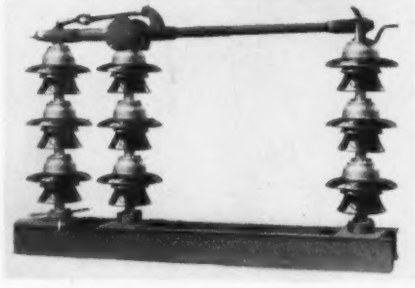
Made in two sizes, 5/32 in. and 3/16 in. in 14-in. lengths. **Lincoln Electric Co.**, Cleveland, Ohio

A new field for welding is opened up by this new phosphor bronze arc-welding electrode. "Aerisweld," as the new electrode is called, has been used in the welding of bronze, brass and copper in many applications, such as busbars, large contacts, impeller blades in pumps and turbines, etc. Electrode has also been used for welding galvanized sheets where minimum disturbance of galvanizing is essential.

•

Disconnecting Switch

This vertical break, rotating insulator type disconnecting switch is designed to provide easy operation under all weather conditions. Contact pressure is completely released prior to any movement of the blade in the opening



Type TR-1; ratings from 88-S kv. to 287 kv. inclusive. **Pacific Electric Mfg. Co.**, San Francisco, Cal.

direction. Likewise, pressure is applied only after blade travel is completed. Contact surfaces are provided with silver inserts to prevent formation of high-resistance oxides. The blades are counterbalanced by completely inclosed spiral springs.

•

Illumination Meter

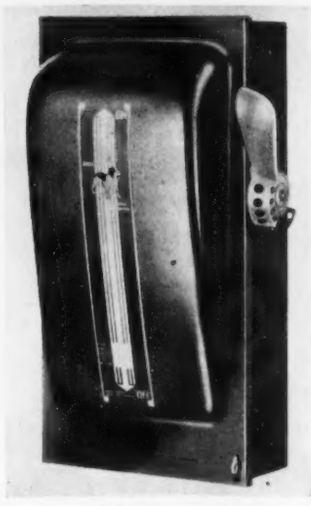
Illumination values as high as 250 ft.-candles are read directly on this illumination meter without using multiplier disks. Low illumination levels are fully and legibly indicated, however, and the whole scale is divided into five seeing zones set off by colored divisions. Back of the indicator contains an embossed metal plate classifying

Dimensions 2⅛ x 2¾ in. Made by **Weston Electrical Instrument Corp.**, Newark, N. J. Distributed by **Sight-Light Corporation**, New York City

seeing tasks completely so that no assumptions are necessary by the user. Light sensitive cell is located within the scale opening directly on the scale itself.

Safety Switch

Design of this switch differs from others in that the arc-extinguishing structure is on the blade rather than on the stationary contacts of the switch. Arc extinguisher is in



Three types available—weatherproof, wall mounting, and ceiling suspension. **Jefferson Electric Co.**, Bellwood, Ill.

the form of a stationary chamber, totally inclosed except for slots at the bottom to receive the stationary contacts in separate cells. Chamber houses the floating contact blade and it moves with the contact in and out of the stationary contacts. Piston action of the contacts when rupturing in the arcing chamber tends to evacuate the air in the inclosure, minimize burning and restrict the ionizable gas present to conduct the arc.

•

Mercury-Vapor Lamp Transformer

When used with mercury-vapor lamps these transformers and reactors provide the proper voltage for the lamps and keep the current low during the initial starting period. They are designed to give full rated capacity to the lamp and to operate continuously with low temperature rise. Snap-on self-locking plug and jack connections provide quick changes of primary transformer tap to match power supply line voltage.

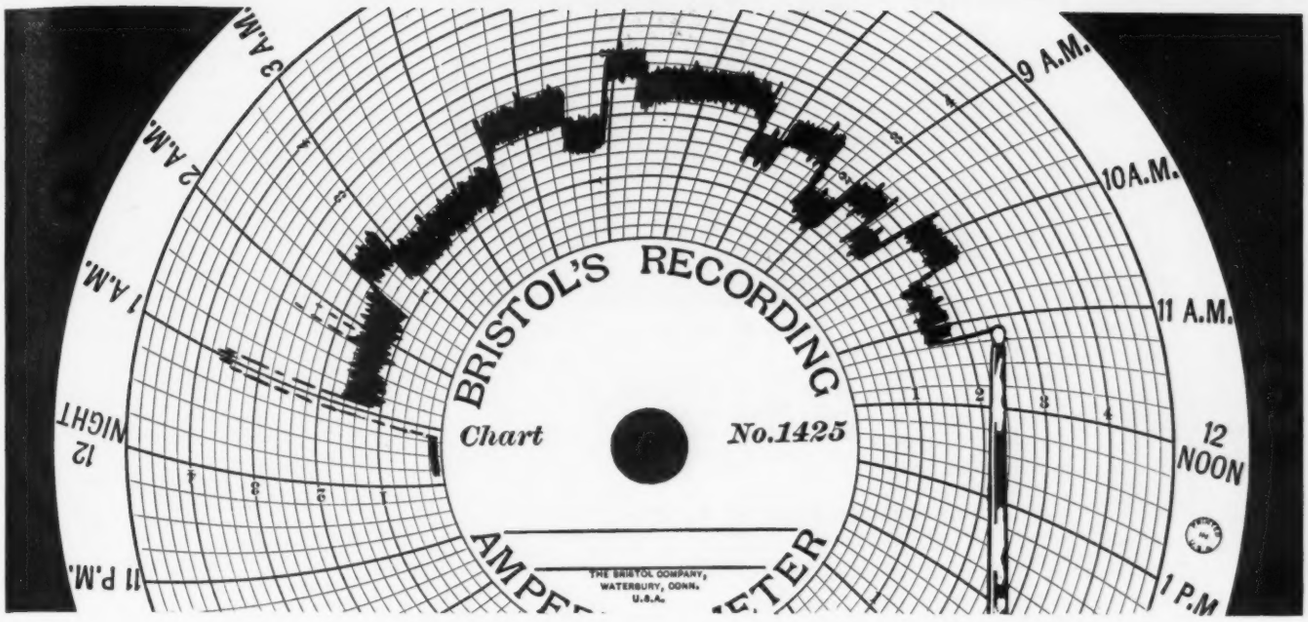
Three types available—weatherproof, wall mounting, and ceiling suspension. **Jefferson Electric Co.**, Bellwood, Ill.

•

Splash-Proof Motors

Ratings from ½ to 200 hp. **Imperial Electric Co.**, Akron, Ohio

Splash-proof, squirrel-cage motors for constant and multi-speed, continuous or intermittent duty in all voltages and cycles for any torque and starting current are available in this make. Construction provides protection against splash or spray and permits proper ventilation through small openings in the bottom of the end brackets for the air intake and louvers in the frame cover underneath the motor for the air exit.



SAFE!

That is the message Bristol's Recording Ammeter flashes when operating conditions are what they should be.

But,—let the motor driving a mixing machine, agitator, wire drawing bench or similar equipment become overloaded, Bristol's Ammeter immediately warns of impending danger. By responding to every fluctuation in motor current faithfully, instantly, it foretells of disaster that may lie ahead—and does so in time for the operator to take the proper corrective action.

For this service Bristol's Recording Ammeter, Round Chart Type, Model 640M is widely used. It supplies a continuous current chart record for periods up to 7 days that may be conveniently filed for future reference and guidance. Write for Bulletin 448.

HOW BRISTOL'S RECORDERS DIAGNOSE PLANT OPERATIONS

AVOID BREAKDOWNS: If you operate mixing machinery or similar equipment that is liable to be overloaded and damaged, a Recording Ammeter installed in the driving motor circuit will give warning immediately of the approach of dangerous excessive loading. It will put a stop to breakdowns, repairs, delays, and loss of production. Also, it will give continuous operating records for future guidance.

STOP BURNING OUT MOTOR: To avoid the possibility of overloading and burning out motors under increased output, it is good practice to install a Recording Ammeter in the motor line and caution operators not to permit the ammeter pen arm to pass the danger point, which for convenience may be marked in red on the chart.

CHECK QUALITY OF STOCK OR PRODUCT: By recording the load on an electric motor and its fluctuations to abnormal values, a Recording Ammeter can be employed to control (a) the consistency of the mix in a motor driven mixer or agitator, (b) the quality of stock such as wire being drawn through a bench, etc. (c) it can even be used to reveal the condition of equipment like revolving knives for cutting up raw material—the duller the blades, the heavier the current on the driving motor.

SAVE POWER COSTS IN MANUFACTURING OPERATIONS: If each department of a plant is provided with a separate Recording Wattmeter, it can very accurately be charged with the exact cost of the power and light it uses. In addition, the power consumption meter charts can be used to reveal the speed or slowness with which the department comes up to full efficiency in the morning and after the noon hour; to show up delays caused by men waiting for materials or instructions, etc. Such charges for individual machines also record how long operators are idle and how much time they waste.

SCHEDULE PROPER LOADING OF POWER EQUIPMENT: By disclosing occasional peaks which fix an unusually high demand power rate for an entire month, a Recording Wattmeter will help arranging production schedules so that intermittently operated machines are not thrown on when the regular plant load is a maximum. This saves money, without adversely affecting plant operation.

THE BRISTOL COMPANY ~ WATERBURY ~ CONNECTICUT

Branch Offices: Akron, Birmingham, Boston, Chicago, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco
Canada: The Bristol Company of Canada, Ltd., Toronto, Ont. England: Bristol's Instrument Co., Limited, London, S. E. 14.

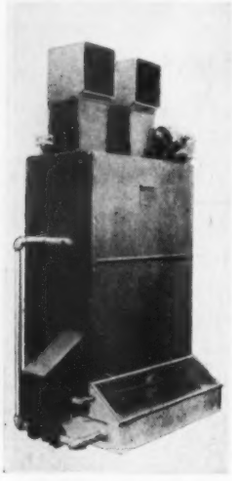
BRISTOL'S

TRADE MARK REG. U. S. PAT. OFF.

PIONEERS IN PROCESS CONTROL SINCE 1889

Air Conditioning Economizer

Designed for two purposes—to save water costs for users of air conditioning, and to eliminate possibility of water shortage—this economizer is fundamentally a combination forced draft cooling tower and refrigerant condenser. A fan passes air through a bank of pipe coils over which water trickles in a direction opposite to the air flow. Refrigerant is condensed inside the coils and flows by gravity to the liquid receiver built in the base. Cooling water is recirculated from the drain pan by a small motor-driven pump.

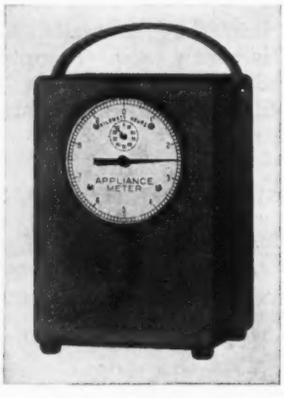


Built in a number of models, capacities from 3 to 50 tons of refrigeration; larger sizes to order. **York Ice Machinery Corp.**, York, Pa.

•

Appliance Meter

An "appliance meter" or especially designed watt-hour meter for measuring the amount of energy consumed by a domestic electric appliance during any period is now obtainable. This meter is for use by utilities and dealers as a tool in connection with sale and service of appliances. Tests with the instrument are made in the customer's home under actual service conditions. Two circuit connections in the back of the case provide one outlet for the appliance plug and another for circuit connection.

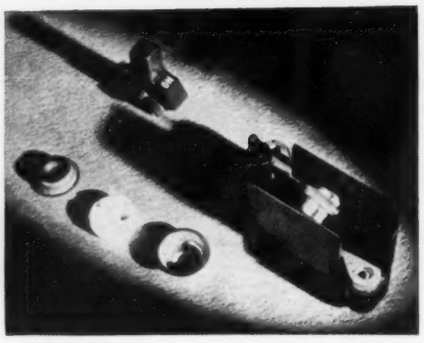


Two- and three-wire types available, each supplied with either standard or fast-moving registers; standard (shown) is equipped with pointer that sweeps scale from 0 to 10 kw.-hr.; small dial indicates totals up to 100 kw.-hr. **Duncan Electric Co.**, La Fayette, Ind.

•

Silent Switch

Silent operation is the feature claimed for this new switch, which contains no moving parts. Switch for use on low-voltage wiring circuits consists of two shallow steel cups sealed together with lead glass to form a hollow compartment. Separating the cups is a disk of ceramic material in which there is a small hole located near the edge. The compartment is evacuated and in it about 4 grams of mercury are inserted. After inserting the mercury the compartment is filled with hydrogen and sealed. In the "off" position the hole in the ceramic insulating disk is above the line of the inclosed mercury. When rotated 20 deg. the mercury flows through the hole, establishing a contact between the cups and closing the circuit.



General Electric Co., Schenectady, N. Y.

•

Industrial Analyzer

Case dimensions 8 x 11 x 13 in. **Westinghouse Electric & Mfg. Co.**, E. Pittsburgh, Pa.

This instrument cuts set-up and testing time by making it possible to measure direct-current voltage, current or resistance with the minimum of connections and with only one self-contained unit. Two instruments are mounted in the analyzer, an ammeter with self-contained shunts for 7½, 75 and 750 amp. and an instrument that measures volts and ohms. The voltage ranges are 150, 300 and 750. The ohm ranges are 5 and 500 at the center of the scale.

•

Guy Puller

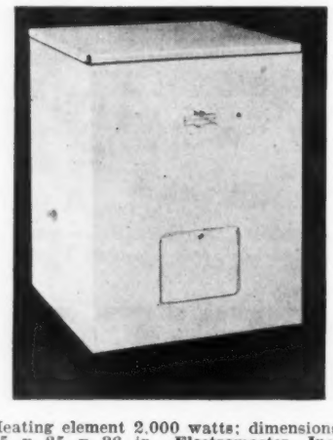
"CM Puller:" two capacities available, ¾ ton and 1½ ton. **Chisholm-Moore Hoist Corp.**, Tonawanda, N. Y.

Efficient gear reduction provides for a minimum amount of effort to operate this new puller for tightening guy wires and for general maintenance and construction service. A double-duty steel chain, which cannot kink or strain in handling, is provided. Operation of the puller is controlled by two buttons which permit quick adjustment of chain. Mechanism and automatic friction brake are fully inclosed, with no exposed bearings or springs.

•

Water Heater

Electric water heaters in a new "table-top" design which permits utilization of space on the heater top for the preparation of food are now available. The heater has a 30-gal. capacity and its top is finished in porcelain enamel.



Heating element 2,000 watts; dimensions, 25 x 25 x 36 in. **Electromaster, Inc.**, Detroit, Mich.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogs now available to engineers by manufacturers and associations

A Lightning Reference Book, sponsored by the A.I.E.E. transmission and distribution committee and undertaken by the lightning and insulator subcommittee, has now reached the stage where orders are being taken. Subjects covered relate to the nature and characteristics of lightning, field and laboratory tests with artificial lightning, operating performance of apparatus and transmission lines under lightning conditions.

Artificial Light and Its Applications is a 258-page text book covering the lighting field from fundamental theory to all classes of present-day practice. Several sections cover the new vapor illuminants, namely, the sodium and high-intensity mercury vapor lamps which have come into accepted use only recently. The book, which is to be obtained by writing to Westinghouse Lamp Company, Bloomfield, N. J., is replete with tables and illustrations. Cost is 50 cents per copy to cover printing costs.

Methods of Measuring Radio Noise. Report of joint E.E.I., N.E.M.A., R.M.A. coordination committee and designated as EEI, C9; NEMA, 102; RMA, 13, is now available to members and employees for 15 cents and to non-members in the United States for 45 cents. Write to Edison Electric Institute, 420 Lexington Ave., New York City.

Symbols for Metering Diagrams is a new publication (C-10) of the Edison Electric Institute, 420 Lexington Ave., New York City, which is intended to simplify wiring diagrams, standardize and facilitate checking, cost 10 cents.

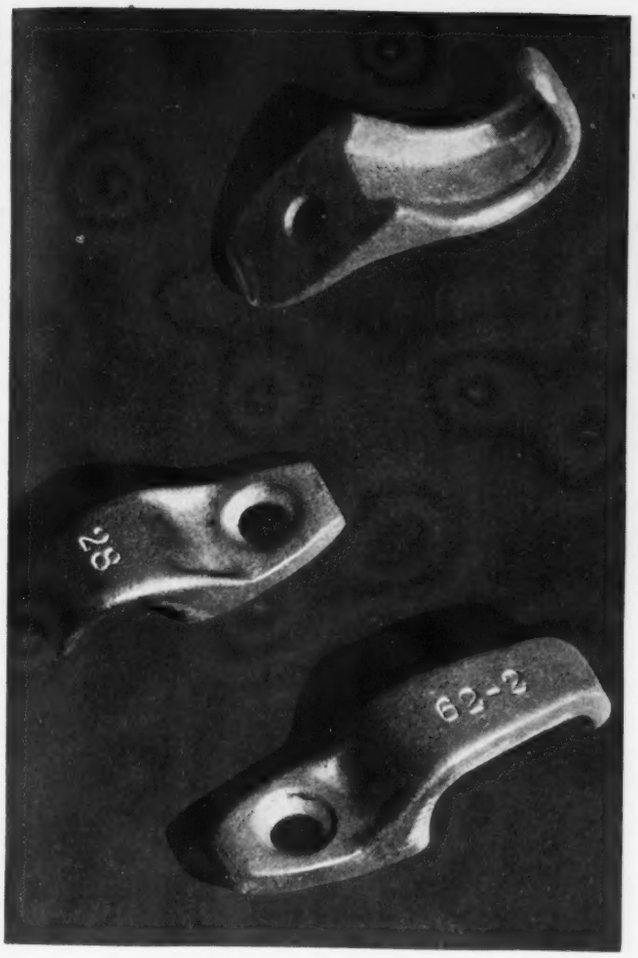
Twenty-Five Years of the Sauter Time Switch is a superbly illustrated jubilee publication which closes by detailing the fabrication and test technique in producing this line of switches handled by R. W. Cramer & Company, New York.

Speed Measuring Instruments, Bulletin 1435 of the James G. Biddle Company, 1211 Arch Street, Philadelphia, describes the operation of a number of different types of hand tachometers.

Canadian Engineering Standards Association has published three more approval specifications under Part II of the Canadian Electrical Code. These constitute specification No. 13-1935, Transformers for Luminous Tube Signs and Oil Burner Ignition Equipment; specification No. 14-1935, Industrial Control Equipment in Ordinary Locations, and No. 19-1935, Soldering Lugs.

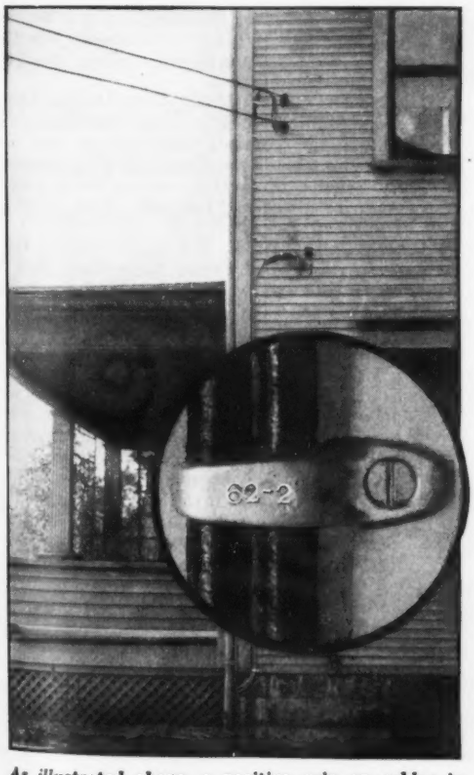
A Wood Handbook, in which the technical properties and behaviors of wood are defined, is a publication of interest to wood users generally. It embodies the results of 25 years research and it treats the facts recently developed in regard to ring placement, the various factors affecting strength, control of decay and insect damage, preservative treatment, and treating for effective fire resistance. Copies are 25 cents each and are obtainable from Superintendent of Documents, Government Printing Office, Washington, D. C.

Complete rating and dimension data on worm gear reducers is given in Book No. 1524, now available from the Link Belt Company, 2045 W. Hunting Park Ave., Philadelphia. Similar information on herringbone gear reducers is given in Book No. 1519, a companion publication.



IT'S NEW~ IT'S NON-CORROSIVE~ IT LASTS A LIFETIME

A non-corrosive clamp for entrance cable that combines serviceability with good appearance. Of cast aluminum alloy, it prevents rust streaks from marring surfaces on which it is attached. A better service is being rendered power and light customers throughout the country where this clamp is used. Write for quantity prices. Samples sent on request. No. 12x1" flat head aluminum wood screws furnished if desired.



As illustrated above, a positive grip on cables is assured when this clamp is used.

CABLE CLAMPS

CAT. NO.	CLAMP SHAPE	CONDUCTOR SIZE		OVERALL DIAMETER OF CABLE INCH	CABLE SHAPE
		INSULATED	BARE		
90	Round	4 No. 8 Solid	1 No. 6 Stranded	.92	Round
		2 No. 4 Stranded	1 No. 4 Stranded	.89	Round
80	Round	6 No. 12 Solid	1 No. 8 Solid	.80	Round
		2 No. 6 Stranded	1 No. 6 Stranded	.80	Round
63	Oval	2 No. 6 Stranded	1 No. 6 Stranded	.6x.8	Oval
36	Oval	2 No. 6 Stranded	1 No. 6 Stranded	.5x.8	Oval
		1 No. 8 Solid	1 No. 8 Stranded	.43	Round 2 cables laid side by side
62-2	Oval	1 No. 6 Solid	1 No. 8 Stranded	.52	Round 2 cables laid side by side
28	Round	2 No. 4 Stranded	1 No. 4 Stranded	.66x.98	Oval
		1 No. 8 Solid	1 No. 8 Stranded	.43	Round
		1 No. 6 Solid	1 No. 8 Stranded	.52	Round

ALLOY ALUMINUM SALES CO.

2412 THIRTEENTH ST., N. E. . . . . CANTON . . . OHIO

New York Representative—Electric Devices Corp., 227-229 Fulton St.

Broader Distribution and Listing of Securities

may well be considered by executives or stockholders who control a closely held corporation. It may be difficult, in the future, to liquidate large holdings of unlisted or inactive securities to provide for high estate taxes. ¶ More favorable conditions today afford an opportunity to improve the liquidity of such holdings. Through distribution of a part, with listing on a stock exchange, a broader public market and enhanced collateral values may be obtained.

F. EBERSTADT & CO.
Incorporated

INVESTMENT BANKING

39 BROADWAY NEW YORK CITY

AN IMPROVED FIRE FIGHTING APPLIANCE-in 1661

● This print — showing equipment used in fire fighting nearly three centuries ago—should prove interesting to anyone concerned with today's problems in fire protection. Watch LUX Fire Protection advertising for further proof of the advances made in fire-fighting appliances.

EVEN FIRES AND THEIR CAUSES ARE DIFFERENT *TODAY*

● The enormous demand on Public Utilities for Power has produced huge and costly generating equipment and with it new hazards. A similar demand for uninterrupted Service has produced *Lux automatic protection.*

Even the unattended substation may today be made safe—Yet this protection costs but a fraction of one percent of the protected equipment. Call on our engineering staff, which has surveyed hundreds of power plants, to assist in the solution of your fire protection problem.

Walter Kidde & Company, Bloomfield, N. J.

Installation of LUX Protection for generator in a large utility company.

MORE THAN 4,000,000 H. P. IS LUX PROTECTED

SALES OPPORTUNITIES IN NEW CONSTRUCTION

BAD AXE, MICH.—Detroit Edison Company, Detroit, plans early construction of new transmission and distributing lines in parts of Huron and Sanilac Counties, Lake Huron Division, totaling about 25 miles, for rural electrification, including service facilities.

GREENWOOD, S. C.—Greenwood County Finance Board of County Commissioners plans to place contracts soon for proposed transmission and distributing lines in parts of Laurens, Greenwood and Newberry Counties for rural electrification, totaling about 100 miles, with power substation and service facilities. Fund of $130,000 has been arranged through Federal aid. E. I. Davis is secretary of board, in charge.

AUSTIN, TEX.—Bureau of Reclamation, Austin, receives bids March 31, for construction of Arnold dam and power plant, Colorado River Project, Texas, including switchyard, gates, gate hoists, power penstocks, control mechanism, cranes, trash rack and other construction; part of materials will be furnished by Government (Specifications 673).

BELLEVUE, OHIO—Is arranging fund of $60,000 for extensions and improvements in municipal electric power plant, including installation of new equipment.

MASON CITY, IOWA—People's Gas & Electric Company, Mason City, plans early construction of about 70 miles of new transmission and distributing lines in parts of Hancock, Cerro Gordo and Worth Counties, for which permission has just been secured, for rural electrification in different areas, including service facilities.

PASADENA, CALIF.—Receives bids until March 18 for two 9,000 kva., self-cooled, and one 12,000 kva., auxiliary air blast, three-phase transformers, with accessories, for use in connection with new transmission line for power supply from Boulder Dam development of Government.

SHAKOPEE, MINN.—Rahr Malting Company, Manitowoc, Wis., plans installation of motors and controls, transformers and accessories, conveyors, electric hoists, elevators and other equipment in new dry malt manufacturing plant at Shakopee. Cost close to $1,000,000.

BROOKLYN, N. Y.—Signal Supply Officer, Army Signal Corps, Army Base, Brooklyn, receives bids until March 27 for 1,550 mast sections (Circular 150); until April 1, for 50 dynamotor units, including mounting (Circular 160).

MOYOCK, N. C.—Virginia Electric & Power Company, Richmond, Va., has approved plans for new transmission line, with number of distributing lines, from Moyock to Coinjock, N. C., and thence to Point Harbor, N. C., about 60 miles, for rural electrification in that area. Cost about $100,000. This will comprise part of such electrification program planned by company, lately noted in these columns.

ROCK RAPIDS, IOWA—Has approved bonds for $200,000 for extensions and improvements in city-owned electric power plant, with installation of new equipment, and will proceed with project at early date. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

ROCHESTER, N. Y.—Rochester Gas & Electric Corporation plans new steam-electric generating plant to cost close to $1,000,000, with turbo-generator units and auxiliary equipment. Proposed to begin work early in spring. New plant will duplicate capacity of similar station, recently completed and now being placed in service.

MINNEAPOLIS, MINN.—Northwest Rural Electrification Company, a subsidiary

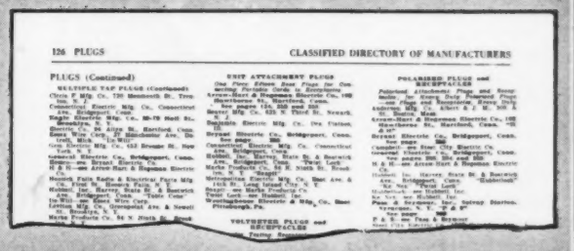
WHO MAKES IT?

Want to know who makes "Electrical Gadgets"? Use your copy of the Buyers' Reference Number of ELECTRICAL WORLD. Turn to the directory section, and you will find a complete list of "Electrical Gadget" manufacturers, plus detailed descriptions in many cases.

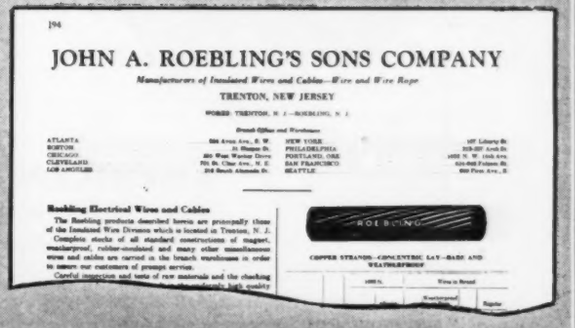
Trying to locate a product with trade name, "American"? A simple reference to the alphabetical tabulation of trade and company names will locate the product for you immediately.

You can save time and money in your buying by simple references to the wealth of handy buying information in the Buyers' Reference Number of ELECTRICAL WORLD. The many time-saving features will make your buying easier — just as they are helping to simplify the work of hundreds of other buyers.

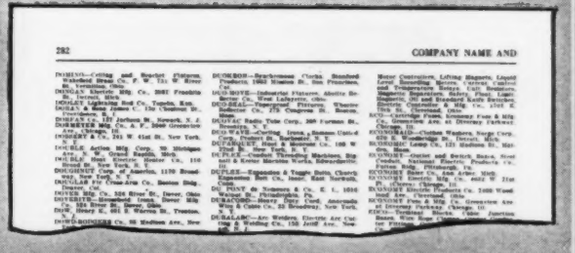
ELECTRICAL WORLD
330 West 42nd St., New York, N. Y.



165 pages of valuable buying data, classifying by products 3500 manufacturers of electrical and allied products — nearly a thousand major classifications.


194
JOHN A. ROEBLING'S SONS COMPANY
Manufacturers of Insulated Wires and Cables—Wire and Wire Rope
TRENTON, NEW JERSEY
Roebling Electrical Wires and Cables

131 pages of product exhibits, giving further information on manufacturers' products, branch offices, warehouses, etc.



33 pages of trade and company names to help locate easily a product where only the trade name or manufacturer is known.

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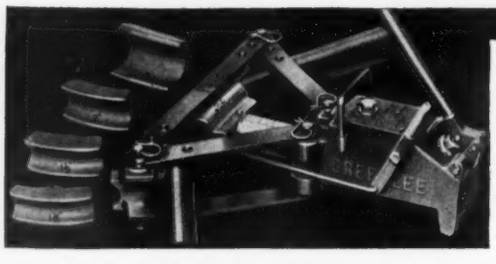


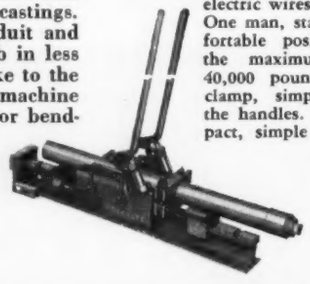
With GREENLEE Hydraulic BENDERS and PUSHERS

•

Above is the Greenlee Hydraulic Bender for rigid conduit and pipe. Note that bending is done by forcing a shoe against the conduit while it is supported at two points by formed castings. Built in two sizes for 1¼ to 3-inch conduit and 2½ to 4½-inch conduit. Does a better job in less time than by other methods. Easy to take to the job and simple to operate. The small machine can be fitted with a set of attachments for bending 1¼, 1½ and 2-inch thin-wall steel conduit.

Literature on Benders and Pushers will be sent gladly. Write NOW and learn how these tools can save money for you.

Below is the Greenlee Hydraulic Pusher, a tool that shows real savings on the underground installation of pipe for electric wires, gas, water, etc. One man, standing in a comfortable position, can exert the maximum pressure of 40,000 pounds on the pipe clamp, simply by pumping the handles. It is very compact, simple to operate, and has capacity for 1¼ to 4-inch pipe.



GREENLEE TOOL CO., *1705 Columbia Ave.*, ROCKFORD, ILL.

of Montana-Dakota Power Company, Minneapolis, plans early construction of new transmission and distributing lines in Ward, Golden Valley, Burke and Mountraill Counties, N. D., and Wibaux and Fallon Counties, Mont., for rural electrification, totaling about 115 miles, with power substation and service facilities. Fund of $146,000 has been secured through Federal aid.

TOLEDO, OHIO—Pure Oil Company, Chicago, Ill., plans installation of motors and controls, conveyors, electric pumping equipment, transformers and accessories, compressors and other equipment for new addition in oil refining plant at Toledo. Cost about $700,000.

KNOXVILLE, TENN.—Director of Purchases, Tennessee Valley Authority, Knoxville, receives bids until March 20 for ventilating and air-cooling equipment for Norris hydroelectric power plant.

SAN DIEGO, CALIF.—San Diego Gas & Electric Company plans installation of ornamental lighting system in business district and Mission Hill section, San Juan Capistrano. Surveys and estimates of cost will be made soon.

COLUMBUS, NEB.—Loup River Public Power District, Columbus, C. F. Fricke, president, will soon complete revised plans for about 48 miles of new 12,000-volt transmission lines and about 300 miles of distributing lines for rural electrification system, including power substation and service facilities. Fund of about $400,000 will be arranged through Federal aid.

PARAGOULD, ARK.—Receives bids until March 25 for new city-owned electric power plant and equipment. Fund of $190,000 has been secured through Federal aid. W. A. Fuller Company, 2916 Shenandoah Avenue, St. Louis, Mo., is consulting engineer.

EL PASO, TEX.—Quartermaster Corps, United States Army, William Beaumont General Hospital, El Paso, receives bids until March 19 for extensions in electrical distribution and street-lighting systems, including transformer facilities, etc. (Circular 15).

GRAND FORKS, N. D.—Northern States Power Company, Minneapolis, Minn., plans extensions and improvements in power plant and power substation at Grand Forks, with rebuilding, improvements and additions in transmission and distribution lines in that area; expansion and improvements will be carried out in power plant at Fargo, N. D., with installation of new mechanical stokers and other equipment; similar work will be carried out at power station at Minot, N. D., where steam boiler equipment and accessories will be installed.

OMAHA, NEB.—Armour & Company, Union Stock Yards, Chicago, Ill., plans installation of motors and controls, conveyors, loaders and other equipment in new addition to meat-packing plant on Thirtieth Street, Omaha. Cost over $400,000.

CHARLOTTE, N. C.—Duke Power Company, Charlotte, plans new transmission and distributing lines in part of Chester County, S. C., for rural electrification, including power substation and service facilities. Cost over $60,000.

GRAND HAVEN, MICH.—Petroleum Chemicals Co., Detroit, Mich., care of George H. Flynn, National Bank Building, Detroit, recently organized with capital of $1,000,000, plans installation of motors and controls, transformers and accessories, compressors, conveyors, electric pumping machinery and other equipment in new oil refinery and by-products plant on tract of land just acquired at Grand Haven. Cost about $300,000.

BOGUE, KAN.—Plans new transmission line with power substation facilities for local service. Estimates of cost being made. F. L. Werhan, Hays, Kan., is consulting engineer.

BOOK REVIEWS

National Electrical Code Handbook

By Arthur L. Abbott. Published by McGraw-Hill Book Company, 330 West 42d Street, New York City. Third edition, 547 pages, illustrated. Price, $3.

As in previous editions, the new handbook interprets the latest (1935) N.E.C. in all its sections. This third edition has been made more usable by collecting all the data tables in the final chapter and thus they do not have to be hunted through the book.

•

A Fugue in Cycles and Bels

By John Mills.

The price of this illustrated book is $3 and not $5, as stated in the review published December 7, 1935.

•

Uniform System of Accounts for Electric Utilities

By National Association of Railroad and Utilities Commissioners. Published by the State Law Reporting Company, 30 Vesey Street, New York City. 312 pages. Price, $2.

The official version of the proposed revision of the uniform system of accounts for electric utilities prepared by the committee of the regulatory authorities is ready for study by the industry. New details are introduced affecting small (up to $750,000 annual utility revenue) as well as large companies. More refinement in unit property entries is prescribed. Straight-line depreciation is given strong preference, but exceptions are afforded for specially demonstrated cases.

•

Hot Water and Steam Supply by Electricity

By F. C. Smith. 142 pages, illustrated. E. and F. N. Spon, London; Engineers Book Shop, New York. Price, $3.50 in U. S.

A fundamental treatise on heating water and making steam by use of electric heat. It gives the basic data and equipment in simple terms for those interested in these applications. European devices are described, including boilers, heaters, resistance units and accessories. Typical installations are shown, with detail of design as well as heat calculations.

•

Air Conditioning for Comfort

By Samuel R. Lewis. Published by Keeney Publishing Company, Chicago. 271 pages, illustrated. Price, $2.50.

In revising the material the author has been successful in eliminating lost motion so that the facts about air and air conditioning can be applied quantitatively in the most direct manner, enough is given about apparatus to guide the computations properly and then the theoretical expressions are presented primarily as starting points for numerical solutions of working cases.

Emphasis is placed on the psychrometric table rather than the chart, although the latter (ASH&VE) is bound in as a 10x18-in. supplement. Body, walls, sun, lamps, venti-

COIL CONSTRUCTION OF WAGNER TRANSFORMERS has THESE ADVANTAGES

Photo N459B — *Core-type low-voltage transformer coil. 5 kva coil shown.*

Photo N207 — *View of one limb of a core-type transformer with one high voltage section removed. The high-voltage coils are wound in sections and separated by insulating washers. (See Photo F1066.)*

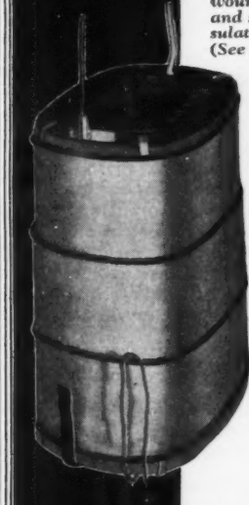


Photo F1066— — *One limb of a 75 kva, 6900 volt to 115/230 volt core-type transformer coil. Pressboard washers separate the high-voltage winding into sections to reduce the voltage between layers and coils.*

1. All coils are form-wound.

2. End-turns are extra heavily insulated and definitely spaced to resist line disturbances.

3. Insulating barrier used between windings consists of flexible mica, varnished muslin, pressboard, and muslin-tape, in addition to the conductor insulation.

4. Taps are brought out from the middle of the winding where they do not interfere with the surge resisting design of the coils.

5. Copper conductors are either round, square, or rectangular in cross-section, suitably insulated — depending upon the best design suitable for the kva rating and voltage.

6. Large creepage distances between the high-voltage and the low-voltage windings and between the windings and yoke iron are definitely maintained by the use of insulating strips built to the height of the conductors.

7. All finished coils are wrapped with linen tape before treating.

If you want complete "details", not only of coil construction, but also of cores, assembly, winding treatment, tanks, bushings, accessories, etc., write for Bulletin 180.

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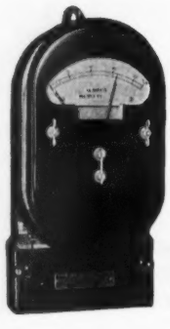

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lation, air distribution and water circulation are given successive attention in quantitative terms. The four final chapters treat specific cases of heating and cooling a residence and a commercial building, each ending with an elaborate tabulation of the given data and the derived quantities which dictate the installation.

•

Homeowners Handbook

Housing Publications, Inc., 25 West 43d Street, New York City. 255 pages, illustrated. Price, $0.50.

Stimulation of home modernization should be the result of this appealingly illustrated treatment of how to plan remodeling intelligently, what to buy, who makes it, how best to apply it and keep it in good condition. Wiring, lighting and air conditioning are treated briefly by themselves, but the former are mentioned many times as reminders in discussing specific rooms, attic to cellar. The book teems with valuable tips on doing an acceptable and durable job of reconditioning. Utility home service departments can use it advantageously to supplement coaching on electric advances in the home.

•

Rural Electrification

By J. P. Schaenzer. Published by Bruce Publishing Company, 524 N. Milwaukee Street, Milwaukee, Wis. 266 pages, illustrated. Price, $1.72.

Addressed to vocational agricultural classes, this text starts each chapter with questions, demonstration outline and practice topics. Explanatory information, well illustrated, follows in each of the 25 chapters from elements of electric generation and distribution through wiring for light and power to the dozen chapters devoted to specific applications like feed preparation, hay hoisting, plant forcing, etc. State bulletins, C.R.E.A., N.R.E.P. were drawn upon as well as the author's experience as project director, rural electrification, for the University of Wisconsin. Utility rural service workers will find here much that is otherwise widely scattered in agricultural bulletins.

•

Elements of Electrical Engineering

By A. L. Cook. John Wiley & Sons, Inc., New York. 603 pages, illustrated, third edition revised. Price $4.

This is a revised edition of this fundamental textbook. New matter has been introduced, including more on instruments and the use of complex quantities for the solution of circuit problems. The text covers fundamental electric and magnetic circuits, direct-current machinery, alternating-current machinery and circuits and electron tubes. It is written as an elementary and practical text for non-specialized electrical students.

•

Symposium on Illumination

Edited by C. J. W. Grieveson. Published by Instruments Publishing Company, 1117 Wolfendale Street, Pittsburgh, Pa. 229 pages, illustrated. Price, $4.50.

Nine recognized experts delivered as many lectures on their specialties under the auspices of the National Illumination Committee of Great Britain and the I.E.S. in 1933 and they are collected here. They co-ordinate the essentials of radiation physiology, lamp characteristics, photometry, reflector technology, decorative lighting, highway

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lighting, industrial lighting as these practices have been evolved to meet European needs. For lectures, an uncommon amount of technical information in the form of tabulated data and graphs is incorporated, useful in design and analysis.

•

Mechanical and Electrical Equipment for Buildings

By C. M. Gay and C. De Van Fawcett. John Wiley & Sons Inc., New York. 428 pages, illustrated. Price, $5.

This is a textbook developed by an architect and an electrical engineer who are experienced as teachers and consultants. It meets the demand for a fundamental treatise on heating, air conditioning, electrical layout, lighting, elevators, acoustics and other aspects of modern buildings. It is not a handbook and tries to outline principles. Typical sections cover water supply, plumbing and drainage, heating and air conditioning, electrical equipment and acoustics. The book should be useful as a text and as an aid to all architects and engineers who encounter problems in connection with modern buildings.

•

Experiments and Tests on Electrical Circuits and Machinery

By H. R. Reed, associate professor of electrical engineering, Michigan College of Mining and Technology, Houghton, Mich. Litho-printed by Edwards Brothers, Ann Arbor, Mich. Fifth edition, 166 pages; illustrations, diagrams, graphs; cloth, boards. Price, $2.

This book is intended as a laboratory text for students majoring in electrical engineering, but it may be as readily used by other engineering students. As a matter of fact, this book should be pretty valuable to the ambitious young electrician who is forced by economic circumstances to dig out his technical education without academic aids. Part I deals with elementary electrical and magnetic experiments. Part II covers d.c. machines, while Parts III and IV are concerned with a.c. circuits and a.c. machines respectively.

•

Phenomena in High-Frequency Systems

By August Hund. Published by McGraw-Hill Book Company, 330 West 42d Street, New York City. 642 pages, charts. Price, $6.

Last year the author's "High-Frequency Measurements" was published and reviewed. This present book is more than "high-frequency phenomena" because it embraces the whole field of phenomena in circuits devised for high-frequency performance. While mathematical in substantiation, it is also explicatory and traces the history of the discoveries that have made modern communication possible. Early chapters take up high-frequency generation, frequency changers, rectification, and inversion, with amplification extensively treated. Extended space is given to electrostriction, electromagnetic theory and upper atmosphere ionization, the text closing with analysis of antenna and directive systems and meshes for filter purposes. The book is manifestly a fundamental and authoritative treatment of the underlying principles and functionings of practically all thermionic and associated devices employed in radio communication. An appendix embraces the requisite mathematical tools and tabular data.

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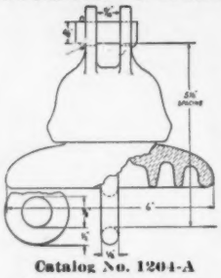

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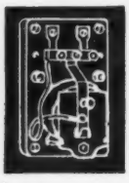

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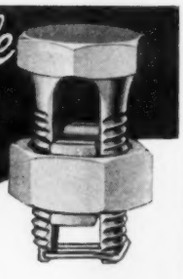

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